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TECHNOLOGY AND MANPOWER IN THE TELEPHONE INDUSTRY, 1965-75.

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ELECTRONIC SOLID STATE SWITCHING SYSTEMS, COMMUNICATIONS SATELLITES, SEMIAUTOMATIC INFORMATION SERVICES, AUTOMATIC INTERCEPTING AND DATA PROCESSING, AND DEDICATED PLANT, THE PERMANENT ASSIGNMENT OF LINES FROM A CENTRAL OFFICE TO EACH ACTUAL AND POTENTIAL SUBSCRIBER, ARE SOME OF THE TECHNOLOGICAL INNOVATIONS WHICH WILL BRING SIGNIFICANT MANPOWER CHANGES IN THE TELEPHONE INDUSTRY DURING THE 1965-75 PERIOD. THESE CHANGES WILL EVOLVE SLOWLY AND WILL PRESENT NO SERIOUS MANPOWER ADJUSTMENT PROBLEM. EMPLOYMENT IN THE INDUSTRY WILL RISE DURING THE 1965-75 PERIOD, ALTHOUGH NOT SO RAPIDLY AS IN THE 1964-65 PERIOD. THIS GROWTH WILL NOT BE SUFFICIENT TO MATCH INCREASES IN THE NUMBER OF PERSONS SEEKING EMPLOYMENT, ESPECIALLY THE YOUNGER AND LESS EDUCATED WORKERS. THE PERCENTAGE OF WOMEN EMPLOYED BY THE INDUSTRY WILL BE SUBSTANTIALLY UNCHANGED DURING THIS PERIOD ALTHOUGH THE NUMBER EMPLOYED WILL RISE FROM 395,500 TO 444,000. LAYOFFS ARE NOT EXPECTED TO BE SIGNIFICANT SINCE REDUCTIONS IN FORCE ARE HANDLED PRIMARILY BY ATTRITION AND REASSIGNMENT. THE SKILL REQUIREMENTS OF THE INDUSTRY WILL GENERALLY BE HIGHER IN THE FUTURE AS THE INDUSTRY WILL CONTINUE TO REQUIRE LARGE NUMBERS OF TRAINED PERSONS. GRADUATES OF 2-YEAR TECHNICAL INSTITUTE PROGRAMS WITH A SPECIALTY IN ELECTRONICS ARE LIKELY TO BE IN PARTICULAR DEMAND. THE OCCUPATIONAL STRUCTURE OF THE INDUSTRY WILL CHANGE SLIGHTLY BY 1975 WITH THE NUMBER OF TELEPHONE OPERATORS AND CLERICAL WORKERS DECLINING SOMEWHAT IN PROPORTION TO TOTAL EMPLOYMENT, WHILE THE NUMBER OF PROFESSIONAL AND SEMIPROFESSIONAL WORKERS WILL GROW SUBSTANTIALLY. THESE PROJECTIONS WERE BASED ON THE ASSUMPTION THAT THE 1975 GROSS NATIONAL PRODUCT WILL INCREASE BY ABOUT 60 PERCENT OVER THE 1965 LEVELS AND THAT PERSONAL CONSUMPTION EXPENDITURES WILL INCREASE BY ABOUT THE SAME AMOUNT. COPIES OF THIS DOCUMENT ARE AVAILABLE FROM MANPOWER ADMINISTRATION, OFFICE OF MANPOWER POLICY, EVALUATION, AND RESEARCH, U.S. DEPARTMENT OF LABOR, 14TH STREET AND CONSTITUTION AVENUE, N.W., WASHINGTON, D.C. 20210. (HC)

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Technology and Manpower In The TELEPHONE INDUSTRY 1965-75

U.S. DEPARTMENT OF LABOR: W. Willard Wirtz, Secretary

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MANPOWER ADMINISTRATION
Office of Manpower Policy, Evaluation, and Research
Curtis C. Aller, Director

Technology and Manpower in the

TELEPHONE INDUSTRY

1965–75

U.S. DEPARTMENT OF LABOR: W. WILLARD WIRTZ, Secretary
MANPOWER ADMINISTRATION

Preface

Technological, social, political, and cultural changes are continually reshaping the economic structure of the United States. Significant for more than a century, the influence of technology has been especially important in the last two decades. The technological advances made during World War II established the foundation for many entirely new products and industries. More recently, government, military, and space research expenditures combined with greatly increased industrial spending for research and development have produced an abundance of technological developments which promise to have an even greater influence on our economy.

Technological change affects the labor force. Existing occupations are eliminated, others decline in importance; totally new occupations come into existence, job content changes, and new skills are required. Although a wide variety of mechanisms are available to facilitate manpower adjustment to technological change, the need for information lies at the core of each. The U. S. Department of Labor has for many years recognized in its research program the need to provide advance information on the potential impact of technology.

In early 1965, an experimental and demonstration project was launched within the Department of Labor as part of its continuing efforts to refine and improve its research methods. The project was designed to give particular attention to the effect of expected technological changes on manpower requirements, although nontechnological as well as technological factors were examined. Close industry contact was considered particularly important and many interviews were held with persons in companies, labor unions, research organizations, and trade and professional organizations as a means of gaining the insight needed to project specific occupational, skill, and manpower requirements at the industry level. It was expected that this approach would provide information useful for program and policy

development within the Department of Labor and other Government agencies as well as to union and management personnel, the general public, legislators, and local communities who must deal with specific problems relating to present and future conditions.

On a demonstration basis, three industries and functional areas in which technology is expected to have important manpower ramifications were selected and studied. They are: The telephone communications industry, the health service industry (*Technology and Manpower in the Health Service Industry, 1965–75* is now in process), and the design and drafting function (see *Technology and Manpower in Design and Drafting, 1965–75*).

This report was prepared by Sheldon H. Luskin under the supervision of Peter E. Haase, project director, and the general direction of Curtis C. Aller, director, Office of Manpower Policy, Evaluation, and Research.

Contents

Introduction

During the next decade, new technological innovations are expected to result in important changes in telephone company equipment and operations. These changes will have a significant impact on the industry's manpower requirements.

Technology will bring about changes in telephone switching systems, in transmission techniques, in operating procedures, and in methods of telephone installation and repair. Technological innovations such as the electronic central office, satellite communications, pushbutton telephone, and computerized information service will result in not only better, faster, and more convenient service to the consumer but in the addition of many new telephone services not previously possible.

Technological change resulting from telephone industry research may have far-reaching manpower implications throughout the economy. For example, the development of the transistor in the Bell Telephone Laboratories has contributed to the development of the Nation's space program which has resulted in thousands of jobs. Future developments could be equally significant to manpower in other sections of the economy.

Technological change is not new to the telephone industry. Equipment and methods have undergone continued change since the first commercial telephone was installed in 1876. Important innovations such as the dial telephone, first introduced in 1892, microwave telephone transmission, introduced in 1947, and direct-distance dialing, introduced in the early 1950's, have all had significant manpower effects. However, the changes during the coming decade are expected to rival those of any decade in the past.

Technological change is expected to have a significant impact on industry workers during the next 10 years. Many occupations will undergo changes in the skills required and in job content. It is because of these changes in an industry which employs large numbers of people (736,200 persons in 1965) that this study was undertaken.

This report presents a study of technological and other developments affecting manpower in the telephone industry during the next decade. The study utilizes available information and judgments to develop projections of future employment in major telephone industry occupations, to note likely changes in job content, and to point out problems of, or implications for, manpower programs and policies.

The study used 1965 as the base year for projections to 1970 and 1975. The projections are based on the assumption that the 1975 gross national product will increase by about 60 percent over the 1965 level and that personal consumption expenditures, which greatly affect telephone company activity, will increase by about the same amount.

The main body of the report consists of four chapters. The first discusses the structure of the telephone industry and describes its services. The second deals with the impact of technology on telephone industry employment in the past. The third reviews technologies that will be placed into widespread use by the industry in the next 10 to 20 years and discusses their expected manpower effects. The final chapter presents the projected employment level in 1970 and 1975 for the major industry occupations and discusses the implications of the projections for manpower policy.

Overview

The history of the telephone industry[1] in the United States is one of continuing growth and technological change. During the 1950's and early 1960's, virtually all the industry's measures of economic activity were doubled and, in some cases, tripled. Employment, however, exhibited no such trend—increasing only 19 percent over the last 15 years. After rapid growth during the first half of the 1950's, telephone industry employment declined during the second half of the decade. Since 1963, employment has risen sharply. The introduction and adoption of new and improved operating procedures were important reasons for the moderate growth in employment over this period. Although technology has had an important influence on the level of employment, it has affected various occupation groups differently. In some occupations, the laborsaving potential of a new device has been offset by other factors, such as economic growth of the industry.

Changes in Technology and Occupational Structure

During the past 10 to 15 years, all occupation groups in the telephone industry have been affected to some extent by new technology. *Telephone operators* (203,600 in 1965) has felt the impact as much or more than any other occupation group. After reaching a peak in the mid-1950's, employment declined through 1963, increasing again in 1964 and 1965. The introduction and rapid spread of laborsaving devices such as direct-distance dialing, automatic message accounting systems, and automatic intercept equipment, and the completion of conversion from manual to dial of local service

1 As used in this report, the telephone industry includes only those operating companies whose major activity is to place parties in voice contact with one another. The definition is identical to that designated by the *Standard Industrial Classification* as SIC 481, Telephone Communication.

has more than offset the effect of substantial increases in the volume of calls.

Employment of *telephone installers and repairmen* (78,300 in 1965) increased by about 75 percent since 1950, although the number of telephone and private branch exchange (PBX) installations increased much more rapidly. Innovations such as prewired buildings and homes, plug-in equipment, modular replacement of defective components, and greater use of polyethylene and other long lasting materials have increased the repairman's productivity. New technology has changed skill requirements for these workers; increasing them in some cases, reducing them in others.

Employment of *central office craftsmen* (68,400 in 1965) increased at about the same rate as did the number of telephone central offices; however, the introduction and adoption of crossbar switching equipment has considerably affected skills required because craftsmen do more work involving electrical circuits and less involving mechanical components.

Technology reduced both employment requirements for *line, cable, and conduit craftsmen* (36,300 in 1965) and their skill requirements. Development such as PIC cable (wire insulated with polyethylene), ready-access terminals, color coding of wires, microwave transmission, mechanical plows, and other equipment have all had significant manpower effects during the past decade.

Despite a tremendous expansion of telephone company business, the number of *clerical workers* needed by the industry has climbed only 10 percent since 1950 to 159,000 in 1965. The introduction of computers and automatic switching equipment that facilitated billing for toll calls was the major reason for the decline.

The number of professional workers, especially engineers and marketing personnel, grew rapidly throughout the 1950's, reflecting the increasingly complex nature of the industry and its efforts to increase telephone usage and service.

Future Technological Developments

Electronic solid state switching systems, communications satellites, and semiautomatic information service are several of the major innovations which will bring significant changes in telephone company operations, services provided to the public, and employment and skill requirements during the 1965–75 period. A more comprehensive discussion of these and other developments that are expected to have a significant manpower impact by 1975 follows.

1. *Communications satellites* will be used to make available inexpensive, long-distance, point-to-point communications. Overseas long-distance rates, particularly international rates, are expected

MAJOR TECHNOLOGICAL DEVELOPMENTS—THEIR IMPACT AND DIFFUSION

Technology	*Occupation groups affected*	*Rate of diffusion*
Communications satellite	Telephone operators (indirectly)	Half of all overseas calls will go through communications satellites by 1975, two-thirds by 1980.
Electronic central office (ECO)	Central office craftsmen	Twenty-five percent of all lines will be served by 1975, 100 percent by 2000.
Traffic service position (TSP)	Telephone operators	Seventy percent of all long-distance calls will go through TSP by 1975; 100 percent by 1985.
Automatic intercepting	Telephone operators	Will grow slowly to 1975, and rapidly thereafter.
Semiautomatic information system	Telephone operators	Will grow slowly to 1975, and rapidly thereafter.
Dedicated plant	Telephone installers Central office craftsmen Construction workers	Will spread rapidly.
Automatic data processing	Office workers	Will spread rapidly.

to drop when the satellite becomes the mainstay of the overseas international communications network. By 1975, projections are that 50 percent of overseas long-distance calls will go through satellites. Manpower will be only indirectly affected. The increasing amount of telephone communications as a result of satellites will tend to swell employment, particularly of operators engaged in overseas communications.

2. *The electronic central office* (ECO) represents a significant change and the first major application of solid state electronic systems in the telephone industry. It will result in faster and more flexible switching systems, which will provide many new services to the customer. The manpower impact will fall mainly on the central office craftsmen category, whose members will need training in electronics principles to complete nonroutine repairs. Some repair and maintenance operations, however, will require less skill than at present. The number of these workers will grow at a rate slower than that of total central office craftsmen as a direct result of electronic central office technology.

3. *Traffic service position* (TSP) will replace the cord switchboard for handling person-to-person, collect, credit card, and certain other types of toll and personal assistance calls. The TSP will reduce the amount of operator worktime per call by around 25 to 30 percent. The demands of TSP on the operator are those concerning assistance to the public. Projections indicate that by 1975, about 70 percent of operator assisted toll calls will be handled by TSP, and by 1985, the conversion from switchboards will be complete. The development will tend to reduce the number of telephone operators needed in the industry in relation to the number of operator assistance calls made.

4. *Automatic intercepting* may reduce the number of calls requiring an operator's assistance or the amount of time an operator spends on each intercept call. Under one such system, the amount of operator time spent on an intercept call is reduced by a minimum of one-third.

5. *Semiautomatic information service* will enable a telephone operator to provide a requested telephone number using an electronic processor instead of a telephone directory. This technology is still in an experimental stage and by 1975, if successful, will be in only limited use.

6. *Dedicated plant,* which provides for the permanent assignment of telephone lines from a central office to each actual and potential subscriber, will tend to reduce the need for cable and telephone installers, construction workers, and central office craftsmen. Introduction was started in 1962, and industry experts expect the use of dedicated plant to accelerate during the coming decade.

7. *Automatic data processing* is expected to be used to an increasing extent by the telephone industry during the coming decade. Increases will be especially significant among functions for which computers have been used to only a limited extent. The impact will fall primarily on clerical workers, although other occupation groups will also be affected.

In addition to these seven technologies, other technologies now in the research or development stage have been widely publicized, but industry experts do not expect these to be introduced on a wide scale until sometime after 1975. Four of these are picturephone service, pulsecode modulation, laser transmission, and helical waveguide transmission. Barriers to early widespread use of these innovations include technical breakthroughs that must be made, high costs, and the lack of mass markets necessary for the economic use of the technologies. In addition, the technical possibility exists that sometime beyond 1975 a semiautomatic information system with audio response will be introduced in large cities. However, it should be emphasized that such a system is not currently planned for introduction by any telephone company.

Employment Projections

Employment in the telephone industry is projected to increase during the next decade from 736,200 in 1965 to nearly 820,000 in 1975. Although this represents an increase of only about 80,000, nearly a million workers (about 85,000 a year), half of them telephone operators, will have to be hired during the next decade to replace workers who die, retire, or leave the industry for other reasons. Some change in the occupational structure is expected during the next 10 years. Highlights of the occupational projections are:

Employment of *telephone operators* will increase only slightly (less than 1 percent per year). The significant technological changes and innovations that will be introduced will nearly offset the effects on employment of huge increases in telephone

company traffic, especially toll and information calls.

The demand for *central office craftsmen* is expected to increase throughout the projected period; by 1975 about 79,000 of these workers will be employed. Despite this rapid growth, no difficulty in meeting the need for central office craftsmen is anticipated because the telephone industry will provide training in handling the repair and maintenance operations on the complex central office switching equipment as needed.

An increase in *telephone installers and repairmen* is expected to occur over the 1965–75 period. By 1975, 85,000 of these workers will be employed in the industry.

The number of *line, cable, and conduit craftsmen* is expected to increase slightly during the next decade as large increases in miles of wire and cable affect productivity gains. By 1975, 38,000 of these workers will be employed.

Projections for the number of *clerical workers* show a gradual increase through 1970 to a total of 165,000 and then some leveling off through 1975. Despite the stability, an estimated 40,000 persons must be hired over the decade to replace workers who leave. Significant changes in the occupation structure of the clerical worker category are anticipated. The demand for workers in unskilled and semiskilled occupations—such as messenger, file clerk, and accounting machine operator—are expected to decline, while the demand for keypunch operator, electronic data processing machine operator, and other jobs involving computer setup and operation will show large increases.

The need for *professional and semiprofessional* workers will increase faster than will the need for any other group of workers. By 1975, it is expected that employment of these workers will increase by nearly 40 percent, to about 98,000. Growth in the numbers of workers in these occupation categories will stem from the increasingly complex nature of the equipment used in the industry. Many new occupational specialties will be included in the category by 1975, as greater use is made of complex computers, switching equipment, and PBX equipment.

Implications for Manpower Program and Policy

The introduction of new technical innovations is expected to result in significant manpower changes during the next decade. These changes, however, will evolve slowly and will present no serious manpower adjustment problem to the industry.

The study made no effort to carry out a systematic analysis of the interrelation of the various manpower programs with the needs and opportunities of the telephone industry. However, in summarizing the manpower program and policy implications of the report, four points are significant:

1. *Employment in the telephone industry will rise during the next decade, although not as rapidly as in 1964 and 1965.* This is in marked contrast to the steady declines that occurred in the 1957 to 1963 period. The rate of employment growth will not, however, be sufficient to match increases in the number of persons who will be seeking employment during the next 10 years. Telephone industry employment is expected to drop to about 0.93 percent of total civilian employment in 1975, compared to 1.02 percent in 1965 and 1.18 in 1957.[2] The declining proportions of the labor force employed by the telephone industry will be especially significant to younger and less educated workers because little or no employment growth in the telephone industry is anticipated in occupations which employ such persons. These workers are typically employed as telephone operators, clerical personnel, cable splicers' helpers and in other unskilled and semiskilled occupations. However, it must be emphasized that despite the slow growth in total employment, the industry will require approximately 90,000 new workers per year —nearly all young persons directly from high school or college—in order to replace workers who leave the industry.

2. *The percent of women employed by the telephone industry will be substantially unchanged during the next decade.* The proportion of women to all telephone industry workers will decline, but only slightly—from 55.6 in 1964 to 54.4 in 1975. The total number of women employed in the industry is expected to rise from 393,500 in 1965 to 444,000 in 1975.

3. *Layoffs in the telephone industry are not expected to be significant.* Reductions in force have in the past and are expected in the future to be handled primarily by attrition and reassignment.

[2] The civilian labor force is projected to grow by about 20 percent by 1975. See "Labor Force Projections for 1970–1980," *Monthly Labor Review,* February 1965, pp. 129–140.

4. *The skill requirements of the telephone industry will generally be higher in the future—the industry will continue to require large numbers of trained persons.* Although it is anticipated that telephone companies will provide much of the training needed, opportunities for placing the graduates of programs established under the Manpower Development and Training Act will exist. The companies are likely to be particularly interested in persons with some training in electrical and electronic principles and techniques to fill the nearly 5,000 central office craftsmen job opportunities expected to arise each year. Graduates of 2-year technical institute programs with a specialty in electronics are likely to be in particular demand to handle nonroutine repairs to the new electronic central office equipment. Young women with a high school education or its equivalent will be needed in large numbers for telephone operator and clerical assignments. Graduates of 2-year, post-high school programs will be required for installing, programing, operating, and maintaining the increasingly sophisticated office management systems and equipment.

1

Industry Characteristics

The telephone industry is one of the Nation's most important industries—not only from the standpoint of services rendered but also in terms of the number of people employed. Over 736,000 persons were employed by the industry in 1965. These persons are employed throughout the country, in rural communities as well as large cities. In 1964, the industry serviced 64 million telephones in the Nation's homes, and another nearly 25 million in a wide variety of businesses.

As used in this report, the telephone industry includes only those operating companies whose major activity is to place parties in voice contact with one another. Telephone company manufacturing, research, and other activities not directly related to the provision of communications service are excluded from this report, as are the activities of nontelephone companies, such as the Western Union Telegraph Company, whose activities overlap, to some extent, with the data transmission activities of telephone companies.

Structure of the Industry

The telephone industry is best described as two separate segments: the American Telephone and Telegraph Company (A.T.&T.) and the "Independent" telephone system. A discussion of the role of each of the two segments is presented below.

American Telephone and Telegraph Company

This company is one of the largest privately owned corporations in the world. With 762,000 employees, the total number of workers in all its divisions, including manufacturing and research, it is second only to the U.S. Government as an employer. It accounts for 84 percent of all the telephones, and roughly 90 percent of all industry workers, operating revenues, and the wire used for telephone service in this country.

This corporation consists of four major divisions:

(see chart 1) (1) An administrative division, the Long Lines division, that provides financial aid, advice, and assistance to operating companies and unites telephone lines of these companies with nearly all other telephones in the world; (2) an operating division that includes 23 operating companies providing telephone service within most of this country's major markets; (3) a manufacturing division, Western Electric, which makes available equipment needed by the operating companies; and (4) a research and development division, the Bell Telephone Laboratories. The first two segments are the major elements of the telephone industry and are referred to as the "Bell System" throughout this report. Of total telephone industry employment in 1965, the Bell System employed over 600,000 workers.

The 23 operating companies, employing nearly 570,000 workers, represent the heart of the Bell System. The companies vary widely in the number of workers they employ and in the size of the area they serve. The largest company employs about 70,000 persons to provide service to over 9 million telephones and the smallest, about 1,300 workers to serve about 75,000 telephones. The area served varies from nine States to a single metropolitan area. The operating companies also differ in rates of growth, and the relative amounts of different equipment used. For example, in Washington, D.C. telephones in use increased by about a third between 1950 and 1960. In contrast, in the area served by the Southern Bell Telephone Company telephones in use increased by 110 percent in the same time period. The use of crossbar switching equipment ranged from a high of about 75 percent in one operating company to a low of 7 percent in another.

Many factors are responsible for this wide variance, including differences in the economic situation of the areas served, types of services demanded, rates of return allowed by different public utility commissions, and market composition of the different areas. The parent A.T. & T. company, recognizing local differences, allows discretion in the use of equipment and marketing procedures.

Despite these differences, the 23 operating companies are similar in many respects: All companies use the same type of basic equipment; organization of the companies is along the same functional lines —with a traffic department, which handles calls and determines equipment requirements; a plant department, which maintains buildings and equipment; commercial and marketing departments, to conduct customer relations and market surveys and accounting; and engineering departments. Comparability among operating companies is encouraged also by the interchange of management personnel.

The other segment of the Bell System, the Long Lines division, functions mainly to connect telephone service among the various Bell operating companies and independent telephone companies. About 90 percent of the 31,000 employees in this division work in the long-distance department providing network service. Another important function of the parent company is to assure comparable service among its 23 operating companies. Although variations are permitted in operating procedures, equipment, employment practices, and other areas, uniform standards and practices are encouraged through an exchange of operating statistics.

Independent Telephone Companies

Nearly 100,000 workers are employed in the 2,550 companies which constitute the "Independent" segment. Independent telephone companies operate 14.2 million (16 percent) of the Nation's telephones. Although the independents use equipment similar to that used by the Bell System, they use larger proportions of equipment associated with low traffic volume. Also, although the independents can provide most of the same services offered by the Bell System, a slightly larger proportion of the independents' telephones serve residences than those of the Bell System.

The largest independent telephone company is the General Telephone and Electronics Corporation (G.T. & E.). The corporation is composed of 24 operating telephone companies, owns about 35 percent of the telephones operated by the independents, and employs about 42,000 workers. Although service is provided in all parts of the country, the two largest companies are located in Southern California and Florida. These two operating companies account for about 40 percent of General Telephone business and employment. Research and manufacturing services for the General Telephone system and for many other independents are provided by the Automatic Electric Company

Bell System structure 1/

American Telephone and Telegraph Company

Long Lines

195 Broadway Corp.

RESEARCH

OPERATING COMPANIES

Western Electric Company

Bell Telephone Laboratories

Nassau Smelting & Refining Co., Inc.

Sandia Corp.

Teletype Corp.

Bellcomm Inc.

Bell Tel. Co. of Pennsylvania

Diamond State Tel. Co.

Chesapeake & Potomac Tel. Co.

Chesapeake & Potomac Tel. Co. of Maryland

Chesapeake & Potomac Tel. Co. of Virginia

Chesapeake & Potomac Tel. Co. of West Virginia

New Jersey Bell Tel. Co.

New York Telephone Co.

Northwestern Bell Tel. Co.

Southern Bell Tel. & Tel. Co.

Wisconsin Tel. Co.

Indiana Bell Tel. Co.

Michigan Bell Tel. Co.

Ohio Bell Tel. Co.

Southwestern Bell Tel. Co.

Illinois Bell Tel. Co.

Pacific Tel. & Tel. Co.

Bell Tel. Co. of Nevada

Mountain States Tel. & Tel. Co.

New England Tel. & Tel. Co.

Cincinnati & Suburban Bell Tel. Co.

Southern New England Tel. Co.

Pacific Northwest Bell Tel. Co.

Principal W. E. Manufacturing Locations

Allentown Works, Pa.
Baltimore Works, Md.
Buffalo Works, New York
Columbus Works, Ohio
Howthorne Works, Illinois
Indianapolis Works, Indiana
Kansas City Works, Mo.
Kearny Works, N. J.
Laureldale Plant, Pa.
Merrimack Valley Works, Andover, Mass.
North Carolina Works, Winston-Salem, N. C.
Oklahoma City Works, Okla.
Omaha Works, Neb.
Shreveport Works, La.

1/ [illegible] Bell System operations in the United States

—a wholly-owned subsidiary of G.T. & E.[3]

Telephone Industry Services

Voice communication is the most important service provided by the telephone industry, but over the years other important services have been introduced and have grown in importance. This section describes the major services offered by the telephone industry: Voice communications, teletypewriter exchange service, program transmission, and data transmission.

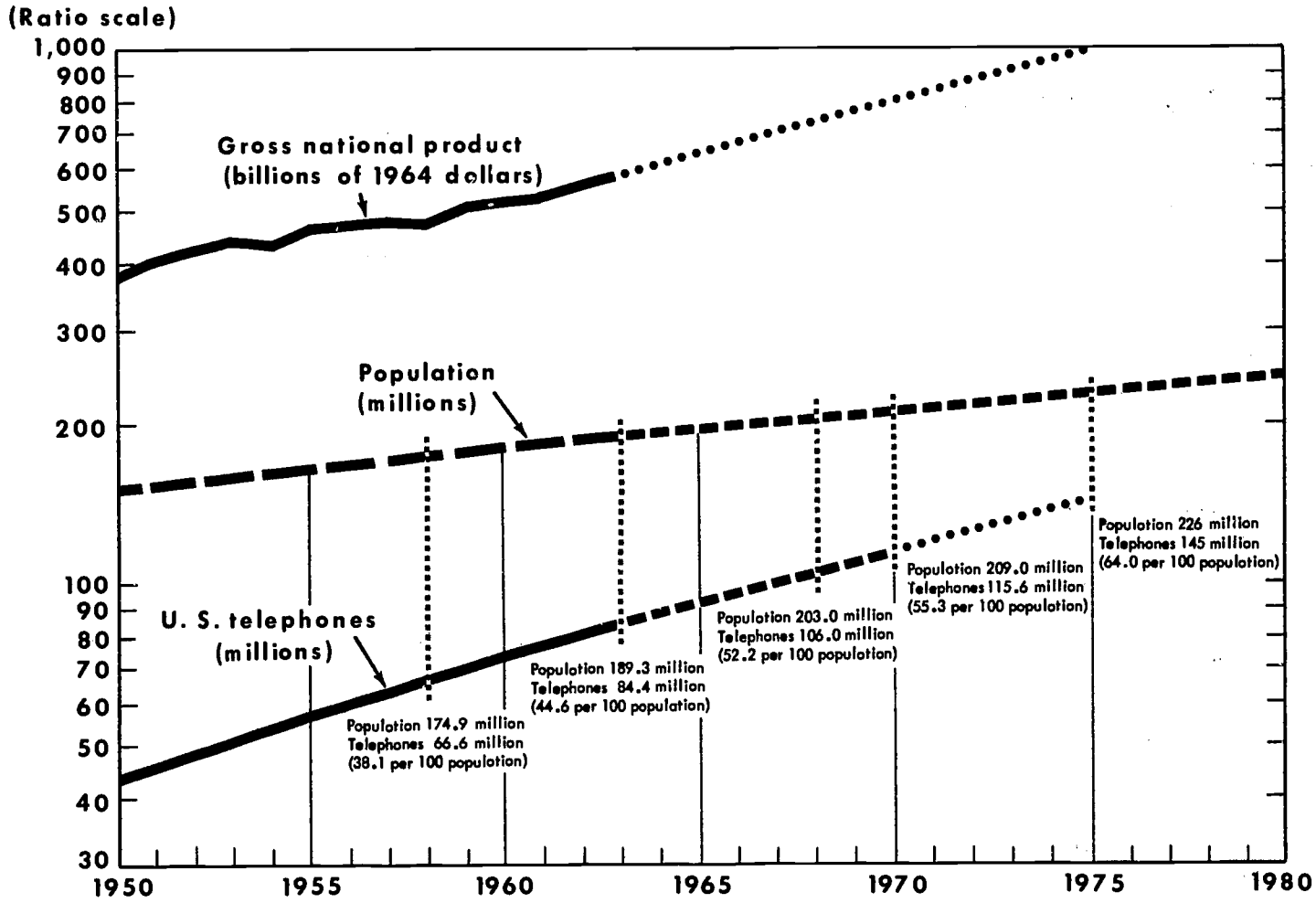
Voice Communication

Telephone service provides practically immediate contact with any other telephone in the country and virtually any other telephone in the world. About 89 million telephones were in the United States in 1964—roughly two telephones for every three people over 13 in the population. (See chart 2.) About three quarters of these telephones were located in homes, and the remainder in a wide variety of locations such as businesses, public buildings, outdoor locations, automobiles, and railroad trains. In 1964, about 112 billion local phone conversations took place—an average of about 310 million a day or nearly two by every three people over 13 in the population. Long distance accounted for another 4.3 billion conversations.

Voice communication accounts for the preponderance of telephone company revenues. About 92 percent of the $112 billion in operating revenues earned by the Nation's largest telephone companies in 1963 were derived directly from telephone voice service; over a third of this revenue comes from toll calls. An additional 4 percent of industry rev-

[3] Other companies which provide equipment to the independents include International Telephone and Telegraph Corporation, North Electric Company, and Stromberg-Carlson Corporation.

Chart 2 U. S. telephone growth



Source: U.S. Department of Commerce. Projection of gross national product from 1963 and U.S. telephones from 1970 by U.S. Department of Labor, Office of Manpower Policy, Evaluation, and Research.

enue comes from telephone directory advertising and other services indirectly related to voice communications.

Teletypewriter Exchange Service

This service permits subscribers to send written messages over telephone company facilities through teletypewriter instruments. About 150,000 Bell System teletypewriter units were in the United States in 1965. This service has accounted for about 2 percent of all telephone operating revenues in recent years.

Program Transmission

Telephone circuits are extensively used for coast-to-coast transmission of television and radio signals as well as for local transmission. In addition to providing the transmission circuits and switching equipment, telephone companies perform other services in connection with program transmission. They test the quality of the signal being transmitted, coordinate audio and visual signals, and, according to the broadcaster's instructions, route the programs to cities scheduled to receive the program by adding or deleting stations from the network.

Although an important service of the telephone industry, program transmission has been one of the minor sources of operating revenue. About 1 percent of revenues is derived from this service. The majority of program transmission is done by the Bell System.

Service provided by some telephone operating companies related to program transmission is the construction and maintenance of community antenna television (CATV) facilities. This is offered in cooperation with CATV companies and makes available improved television reception and additional program material in communities that would otherwise receive weak signals or only a few TV channels.

Data Transmission

This service, introduced for the first time in 1958, permits transmission of digital data over

Data transmission permits communications between electronic data processing centers.

conventional telephone circuits. Data stored by data processing equipment either on magnetic or paper tape or punched cards are converted into forms which can be transmitted over the regular telephone company network. Connections are set up by customers in the conventional manner, or the computing machine may make its own connection automatically. Data transmission has a significant speed advantage over teletypewriter service. Data transmission over conventional telephone circuits can be at a rate of 300 characters per second—more than 10 times faster than teletypewriter service; on broadband transmission facilities, data transmission can range up to 50,000 characters per second.

In 1964, about 10,000 data sets were in operation and accounted for an estimated 1 percent of telephone industry operating revenues. Although this service is currently very small, future growth is expected to be explosive.

2

Technology and Manpower, Past and Present

In the 1950 decade and the first half of the 1960's the number of telephones in use and long distance and local calls nearly doubled, while company operating revenues and miles of wire and cable have increased two and a half times. Telephone long-distance rates have declined, in some cases, quite substantially. The proportion of homes in the United States with telephones has increased from about 62 percent in 1950 to over 80 percent in 1964. The number of telephone central offices has increased by over 50 percent in a comparable period. Practically all other measures of the telephone industry show similar growth. New services that were unheard of a decade ago were introduced and may shortly overtake voice communication as a mainstay of the telephone industry. For example, communication between data processing and computing machines is now not only possible but commonplace. Picturephone, which existed only in the imagination in the early 1950's, is now a technical reality in limited, experimental commercial use.

Despite the rapid growth that has occurred in all sectors of the industry, employment increased by only 19 percent between 1950 and 1965 (from 620,000 to 736,000), with the number employed in some occupations declining. (See table 1.) Total employment peaked at 768,000 in 1957 and then declined for the following 6 years; in both 1964 and 1965, however, it has increased. This limited employment growth is a result of the introduction and spread of technological advances which have tended to make telephone service more efficient while holding down labor costs and stimulating telephone use. Without improved methods, the rapid growth that has characterized the telephone industry in the past would have been impossible.

Change in the telephone industry, as with any other industry, is not characteristic of a single period of time. Nor is change always excitingly

TABLE 1. TELEPHONE INDUSTRY EMPLOYMENT[1] BY OCCUPATION GROUP, SELECTED YEARS, 1950–65

Occupation group	1950	1953	1957	1958	1959	1960	1961	1962	1963	1964	1965[2]
All employees	619,500	702,200	768,200	732,100	707,100	706,000	693,300	687,500	685,500	706,100	736,200
Telephone operators	268,900	290,000	263,600	236,700	223,800	216,300	199,200	190,400	189,200	193,600	203,600
Construction, installation, and maintenance	147,400	161,500	204,400	202,100	197,100	197,200	197,400	200,100	197,400	204,400	210,900
Clerical	112,100	137,800	161,500	153,500	148,100	150,500	150,700	150,600	147,400	152,700	159,000
Professional and semiprofessional	30,400	38,000	50,500	51,100	51,100	53,200	55,900	57,100	64,400	67,600	70,500
Business office, sales, and all other occupations	60,700	74,900	88,200	88,600	87,000	88,900	90,100	89,400	87,000	87,800	92,200

[1] Does not include telephone manufacturing or research activity.
[2] Preliminary.
NOTE: Detail may not add to total due to rounding.
SOURCE: All employment—U.S. Department of Labor, Bureau of Labor Statistics; occupational detail based on data appearing in *Statistics of Communications Common Carriers*, 1950–63 editions, Federal Communications Commission; 1964 data supplied by the Bureau of Labor Statistics; preliminary 1965 occupational detail based on estimates prepared by American Telephone and Telegraph Co.

dynamic or technological in nature. Sometimes change can be as simple as a color telephone or mailing the customer a round disc with his telephone number so that he, rather than a telephone installer, can insert the disc in the telephone. However, all change, whether involving a complex technology or a simple method of operation, ultimately has an employment impact—either influencing the need for workers in a particular occupation or the type of skills necessary to do the job. Limitations of time and space make it impossible to consider all of the changes introduced by the telephone industry in the past decade and a half and their resulting employment effects. However, to gain the necessary perspective to understand the probable effects of technology, it is necessary to understand the effects of major innovations introduced in the past.

Telephone Operators

The largest single occupational category, telephone operators, includes 203,600 workers, nearly all of whom are women. (See table 2.) Telephone operators assist telephone company customers by helping to complete long-distance calls, providing information, or intercepting—informing a caller as to the status of nonworking telephone numbers. Although the vast majority of telephone company revenues come from local services, very little telephone operator assistance is required in this segment of the business. Instead, 68 percent of the telephone operator jobs are in connection with long-distance calls; another 18 percent are those that provide

TABLE 2. TELEPHONE INDUSTRY EMPLOYMENT[1] BY OCCUPATION GROUP, 1965

Occupation group	Number of employees[2]	Percent of total employment
All employees	736,200	100.0
Telephone operators	203,600	27.6
Construction, installation, and maintenance	210,900	28.7
Telephone installers and repairmen	78,300	10.6
Central office craftsmen	68,400	9.3
Line, cable, and conduit craftsmen	36,300	5.0
All other construction and maintenance	27,900	3.8
Clerical	159,000	21.6
Nonsupervisory	146,900	20.0
Accounting department	38,500	5.2
Plant department	37,300	5.0
Commercial department	28,600	3.9
Traffic department	21,900	3.0
All other nonsupervisory	20,600	2.8
Supervisory	12,100	1.6
Professional and semiprofessional	70,500	9.6
Business office and sales	57,800	7.8
Building, supplies, and motor vehicle	25,900	3.5
Officials and managerial assistants	6,500	0.9
All other occupations	2,000	0.3

[1] Does not include telephone manufacturing or research activity.
[2] Preliminary.
NOTE: Detail may not add to totals due to rounding.
SOURCE: Same as Table 1.

information service; and the final 14 percent are concerned with intercept, local assistance, and other types of services.

Telephone companies have introduced improved technology and operating procedures first in areas involving local calls (the largest service offered), and second in the long-distance field. This pattern has been used by the industry for many years to allow the largest portion of the public to benefit from improved service and for the industry to maximize its use of the telephone operator labor force. Thus, the major factor affecting telephone operator employment during the past several decades has been the gradual conversion of the telephone system from manual to dial operation. By 1963, virtually all of the local calls made in this country were placed through automatic dial equipment. Although most central offices were converted from manual to dial during the 1930's, substantial conversion occurred during the 1950's when the proportion of dial telephones increased from 68 percent at the end of 1949 to 94 percent 10 years later.

The advent of the dial system significantly altered the telephone operator's job. With the manual system, a customer's call registered as a light beside a small hole on the operator's switchboard. The operator inserted one plug into the hole and found out from the customer the number he wished to have called. She plugged the other end of the cord pair into the hole representing the called number and rang the circuit. Long-distance calls were completed in much the same manner except that it was necessary for several operators to intercede. In addition, when a long-distance call was made it was necessary for the originating operator to make a written record of the call for billing purposes. Now, all local calls except for emergency and special assistance calls are completed by the automatic switching systems without operator intervention.

At the same time that local telephone operators were being affected by the gradual changeover from manual to dial, many other changes in technology and operational methods were affecting this occupational group. In the late 1940's, arrangements were made to enable long-distance operators to dial some numbers in distant cities directly. This change was made possible by the construction of additional transmission facilities and the use of modern switching equipment. In the late 1950's, the introduction of "mark sense" provided machine readable records on long-distance calls. Instead of preparing a handwritten record of a toll call, the operator used a special pencil to mark an IBM-type card with information that was then used for accounting and billing purposes.

During the 1950's, changes in technology and operating procedures made possible improved service by providing direct-distance dialing for the greatest proportion of toll calls—paid, station-to-station calls from a residential or business phone. These improvements permitted the caller to dial any number in the United States directly, without operator intercession in many cases, and only minimum assistance in other cases. In some central offices no operator assistance of any kind is required as information on toll calls is recorded on Automatic Message Accounting (AMA) equipment. In other offices the operator still has one function—to obtain the calling party's telephone number for billing purposes. Centralized Automatic Message Accounting (CAMA) equipment does the rest. Still, CAMA greatly expedites the work of the telephone operator; the CAMA operator can process as many as 400 calls an hour as compared with about 15 to 20 calls handled by a toll operator using dial equipment.[1]

During the 1960's, older switching equipment was modified to expand the use of AMA at the expense of CAMA. By 1964, about 50 percent of all long-distance calls (out of a potential of nearly 85 percent of all toll calls) were being handled by AMA or CAMA equipment—three-fourths AMA. Thus, as a result of AMA and CAMA, the number of toll calls that an operator could handle doubled between 1955 and 1961, compared with only a 20-percent increase in the previous 6 years. Between 1961 and 1963, the number increased by another 20 percent.

At the same time that direct-distance dialing was spreading, significant changes were made in the way simple intercept calls were handled. In cities where the number of intercept calls was significant, such calls were routed to a recording instead of to an operator. The recording provided the status of the number dialed, and an operator interceded only if special assistance was needed. By 1964, about 40 percent of all intercept calls were handled without operator intervention.

The effect of the changes in technology and

1 Joseph J. Loewenberg, *Effects of Change on Employee Relations in the Telephone Industry* (Harvard University Graduate School of Business Administration: Unpublished dissertation, June 1962), Part II, p. 13.

operating methods on the demand for telephone operators during the 1950's has been to reduce demand for these workers by making operator assistance unnecessary on some calls and reducing the required worktime on others. This downward trend occurred despite substantial increases in telephone company business. Thus, after reaching a peak of 290,000 operators in 1956 (42 percent of total employment), employment declined each year to 1963, increasing again in 1964 and 1965.

Declines in telephone operator employment during the past 10 years have been accomplished by telephone companies without resorting to significant layoffs. The major reason is the high turnover rate common among telephone operators. Approximately 25 percent of all telephone operators leave their jobs every year and although some eventually take other jobs as operators, the great majority leave this type of work permanently. Reasons for leaving are those common to any work force composed of young women: Marriage, family pressures, pregnancy, departure for another area, or additional education. Advance planning has also reduced the need for layoffs. For example, temporary workers are extensively used to fill vacancies prior to any widespread change in technology or operating procedure. Other workers, not needed as telephone operators, are retrained for other industry jobs, and in most cases where a layoff is necessary, reemployment is offered at a later date. Thus, in one community, out of 312 regular telephone operators, only 4 had to be laid off as a result of the cutover to the dial system.

As a result of changes in operating procedures and technology, changes in the job duties and level of skill of telephone operators have been significant. Generally, the physical demands are considerably less rigorous than they were, with the amount of stretching, standing, and reaching greatly reduced. Routine calls are now handled automatically and the operator spends more of her time on calls requiring tact and imagination.

Construction, Installation, and Maintenance Workers

The work of this group involves installation, maintenance, and repair of telephone stations (equipment in the subscriber's home or business); and maintenance and repair of switching equipment (central office devices used to form a pathway between the calling and the called station once a number has been dialed), and transmission apparatus (equipment which transforms voices into electric signals and transmits the signals between stations). Generally, separate groups of workers are concerned with each of these functions—installation and exchange repair craftsmen install and repair telephone stations and PBX equipment on the customer's premises, central office craftsmen work on the complex switching and automatic message accounting equipment located in the central office, and line, cable, and conduit craftsmen install and repair the transmission facilities. In addition to these three groups, the construction, installation, and maintenance category consists of about 28,000 foremen and a few hundred laborers who perform miscellaneous tasks in all three areas.

In general, the effects of laborsaving technology and operating methods have been more than offset by industry growth. Employment of construction, installation, and maintenance workers increased very rapidly through 1957, and then remained nearly constant through the next 5 years while total telephone industry employment was decreasing. As a result, the relative importance of this occupation group increased from about 23 percent of total industry employment in 1952 to about 29 percent of employment in 1965. Within the broad occupation group, increases in the number employed occurred in the central office, and installation and exchange repair craftsmen groups while the number of line, cable, and conduit craftsmen employed was declining. Because each of the three occupation groups included in the broad category involves different duties, and they have been affected by different technologies, each is discussed separately.

The work of *telephone installers and repairmen* has been affected by a combination of technology, new services, and economics. In the past, to install a new telephone, the worker climbed a pole and attached a "drop wire" between the terminal box on the pole and the customer's building. The wire was brought indoors to another junction box, and then to the desired location for the telephone before the telephone was connected. When the customer moved, the telephone instrument was removed and then replaced, and perhaps rewired, when another customer requested telephone service. Although private branch exchange (PBX) installation added many problems to the work of the installer, such installations were infrequent.

Telephone repair work involved mainly replacing badly weathered drop lines and twisted cords that connected the receiver to the telephone set, or tracing circuitry to locate a defect in a telephone instrument and replacing the defective parts or fuses.

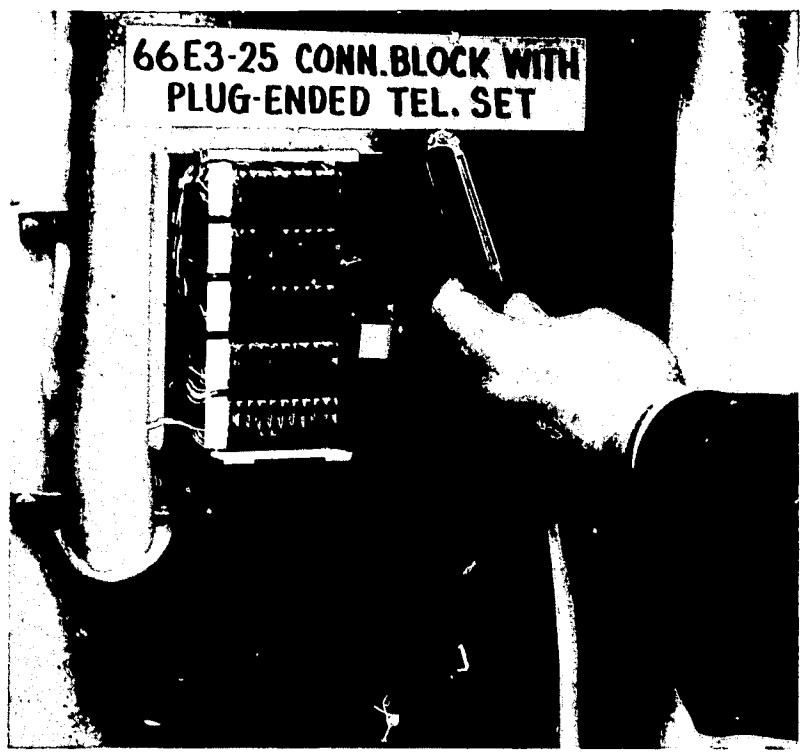
During the 1950's and 60's, the installer-repairman's duties, for many reasons, underwent considerable change. The introduction of new innovations was of considerable importance. Installation duties were greatly facilitated by wiring buildings and homes for telephone service prior to completion of construction and before telephone service was requested. Prewiring is especially valuable in bringing telephone service to desks on an open floor. Metal ducts are imbedded in the floors in a grid pattern and cable can then be pulled through these ducts to the desired location Service to the customer is improved because concealed wiring, usually of primary importance, can easily be provided. Telephone rearranging is likewise simplified.[2]

Repair operations have also been affected by technology. For example, drop lines and other wires are covered with neoprene and cords connecting the receiver to the instrument are coiled, which virtually eliminates the need for their replacement. However, changes in operating procedures had an even larger effect on repair operations. Instead of attempting to repair a defective station on the customer's premises, the installer-repairmen simply substitute a new instrument and return the defective one to the factory or to a warehouse for repairs. Also, tests made from the central office make it possible to give the repairmen a better idea of where he may expect to find the defective part and what remedial practice he should follow.

Another technological advance that has occurred during the 10 years is the use of plug-in equipment. This is particularly valuable for the installation of six-button and other multibutton telephones which formerly required individual fastening for each of the 32 to 50 wires necessary to install such a station. (In 1964, over a million six-button telephones were installed.)

Despite the important effects that changes in technology and operating procedures had on the number of installer-repairmen needed and the skill requirements of their jobs, other factors, especially new services and the expansion of existing services, were at least equally important. For example, the use of complex PBX equipment grew and greatly complicated the work of installer-repairmen. As a result, most telephone companies now recognize work on this equipment as a specialization. Also, the introduction and rapid spread of data transmission and home-interphone systems during the late 1950's made the installer-repairman even more essential. The assignment of additional duties also affected the number of workers in an occupation and the types of skills those workers must have. For example, since the mid-1950's telephone companies have encouraged their installer-repairmen to sell telephone services such as colored telephones, Princess telephones, additional extensions, and home-interphone service when they install a telephone. The adoption of polyethylene insulated conductor (PIC) cable resulted in the installer-repairmen doing some connecting work that was formerly done by cable splicers.

The net result of changing technology, job duties, and telephone industry expansion during the past 10 to 15 years has been to cause increases in the number of telephone installers and repairmen required by the industry. Employment in this category increased rapidly during the early and mid-1950's, from 49,900 in 1949 to 66,400 in 1956 (an average of more than 4 percent per year). Subsequent to 1956, employment in this category in-



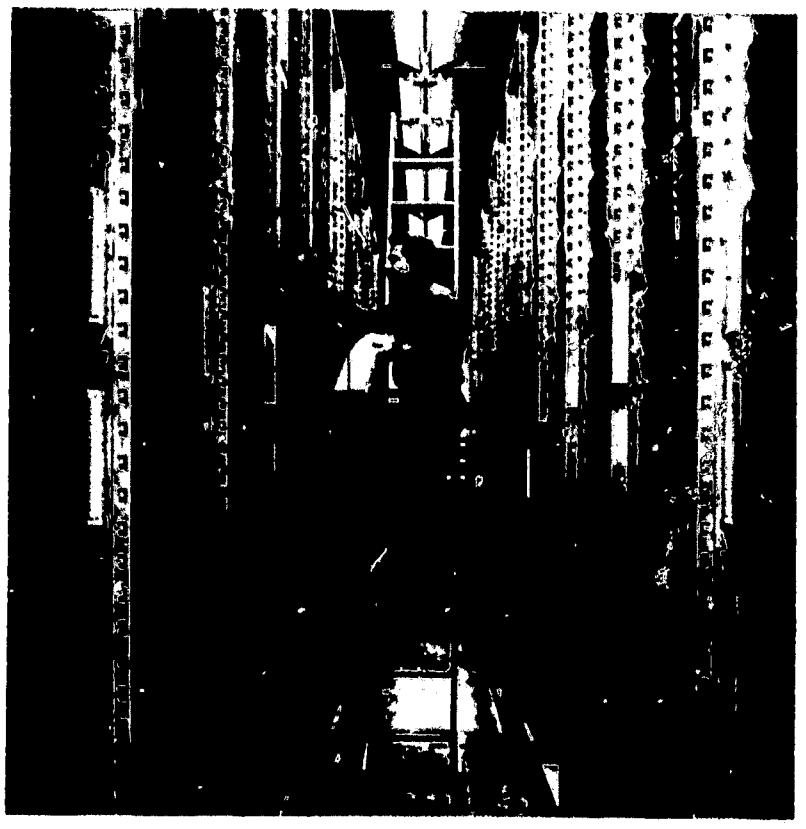
Snap-in adapter for a six-button telephone makes easy installation possible.

[2] The laborsaving aspects of prewiring also, in part, stem from, in a few cases, the installation of the cable system being done by electricians at the same time that the wiring for the electricity is installed, instead of by telephone company workers.

creased much more slowly to 78,300 in 1965 (less than 2 percent a year). Employment changes during both periods were about the same for telephone and PBX installers as for repairmen.

It is difficult to assess the overall effects on the skills needed by workers in these occupations. During the past 10 to 15 years, technological and economic factors operated to both increase and decrease the skill and training necessary to do installation and maintenance work. For example, PBX installation raises skill requirements. On the other hand prewiring, pre-packaged snap-in components, and modular replacement of defective equipment tend to reduce skill requirements.

The work and the skills needed by *central office craftsmen* have undergone considerable change as a result of changes in switching apparatus. These workers are among the most highly skilled employees in the telephone industry. The greatest proportion (about 75 percent), are central office repairmen, who work directly on the complicated switching equipment. Test-board men, the other major group of workers in this category, test and analyze disruptions in telephone service. Frame-



A central office craftsman checks the operation of crossbar switching equipment.

men run, connect, and disconnect wires representing individual subscriber lines between cable and central office terminals according to plans prepared by line assigners, another small group of workers. The frameman's occupation usually serves as a training ground for a more highly skilled central office occupation.

Central office craftsman performs a maintenance operation on step-by-step switching equipment.

The manpower effects of technological change in the central office may be traced through the history of switching equipment. Step-by-step equipment, the first automatic switching system, was introduced with the dial telephone. With the dial telephones, the customer substituted for the operator as the controller of the switching process. Step-by-step equipment still services about half of the telephones currently in operation, particularly in smaller central offices. It makes extensive use of mechanical components, such as rotary switches and relays, to set up a network of metal contacts along which the telephone signal passes.

Panel equipment, the next development in switching, was introduced in 1921. It provided certain flexibilities in operation that made it more suitable to large cities than step-by-step equipment. However, many drawbacks of the early step-by-step equipment remained in the panel equipment. The use of clutches, contact points, and other moving mechanisms resulted in high maintenance requirements. The quality of transmission was adversely

affected by electrical noise stemming from dust and dirt and from deterioration of the contact.

The crossbar system was introduced in the late 1930's to overcome these and other shortcomings. Crossbar equipment works on a completely different principle from previous switching systems. Mechanical components, the mainstay of previous systems, were replaced by a series of bars and springs electrically activated. This equipment allows automatic completion of a call by a secondary route in case the primary route is busy or affected by a malfunction. Although less maintenance and repair work is required on this equipment, locating and repairing malfunctions requires complex circuit analysis. The crossbar switching system represents the ultimate in electromechanical switching and by 1964 was the principal type of switching system being installed by the telephone industry. About 40 percent of the telephones in use were served by crossbar equipment.

Although each generation of switching equipment involved differences in the repair and maintenance skills required by central office repairmen, the changeover from step-by-step and panel equipment to crossbar equipment brought about the most significant changes. Maintenance and repair operations on step-by-step and panel equipment were about half mechanical and half electrical. Physical inspection was usually enough to locate the difficulty on both kinds of equipment, and repairs and adjustments were made by consulting a series of wiring diagrams. Crossbar equipment reduced the amount of time spent on mechanical repairs to 5 percent and increased electrical circuit analysis work to 95 percent. Punched cards issued by the equipment permit the repairmen to go directly to the point of failure and to analyze the circuit and substitute a new part for the damaged one.

Other changes in technology have affected employment in different central office craft occupations. For example, it is no longer necessary for the frameman to solder wires to the frames. Instead, a new tool enables him to attach the wires by winding them around the terminals. Also, the computer which has been used in a few cities to assign wire repairs and telephone numbers, and to prepare instructions for the frameman, has reduced the demand for line assigners.

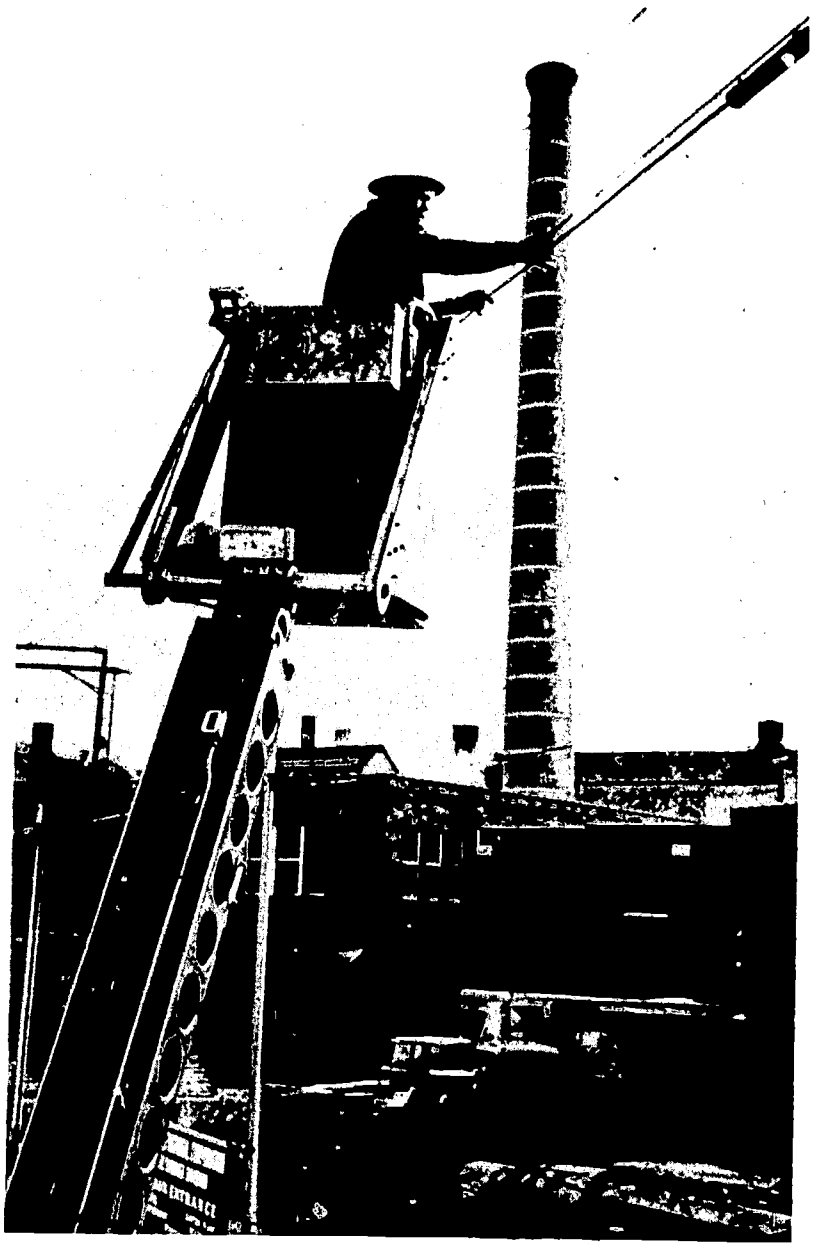
Although crossbar switching equipment tended to reduce the demand for central office craftsmen, very rapid increases in the demand for telephone industry services more than offset this. Increased demand for telephone service was directly responsible for the steady increase in the number of central offices between 1954 and 1964—from an estimated 10,900 to about 14,000. Increasing roughly at the same rate during this period were central office craftsmen—from 48,300 to 67,300. Telephone companies rely on formal and informal company training linked with a promotion from within policy to meet requirements both for the number of workers and the skill level needed for highly skilled central office craft jobs. Thus, inexperienced high school graduates who will later become central office craftsmen usually start as framemen, receiving training on the job. Later, with additional training including classroom instruction, they become specialists in repair and maintenance on the switching equipment used in their central office. When new equipment or tools are introduced, experienced craftsmen are sent to company-sponsored schools where they are taught to work with the new apparatus.

The need for *line, cable, and conduit craftsmen* has been substantially reduced during the past 10 to 15 years as a result of changes in technology and operating methods. The category consists mainly of two groups of workers: Cable splicers (17,000) make and maintain cable and wire connections for both aboveground and buried cable, and linemen (13,500) place underground cable, set telephone poles, and place both aerial and buried cables. Employment in the broad group grew intermit-

Cable splicer selects proper wires in the old lead-sheathed cable.

tently during the first half of the 1950's, reached a peak of 47,000 in 1956, declined steadily to 1963, and then increased again in 1964 and 1965. Thus, in the period between 1956 and 1963, the amount of cable per line, cable, and conduit craftsmen increased by approximately 136 percent, as compared with a 40-percent increase in the previous 7-year period. The number of cable splicers and their helpers needed have decreased throughout the past 10 to 15 years, although the decrease has accelerated since the mid-1950's despite substantial increases in the amount of cable in operation throughout the period. On the other hand, technology seems to have had its greatest affect on the number of linemen needed since the mid-1950's. Employment of these workers grew by about 5,000 in the first half of the 1950's and has remained nearly constant ever since.

The nature of the work of the cable splicer has undergone considerable change in the past 10 to 15 years as a result of changes in technology and operating methods. Prior to the early 1950's the work of the cable splicer involved many unique skills: Cutting into a lead-sheathed cable, selecting the proper wires to connect or terminate by means of a "test-tone", joining the wires to other wires or to terminals, and finally, closing a cable by sleeving it with solder. The cable splicer was assisted in his duties by a helper who was also being instructed in the skills of the work.



Telephone lineman uses a sky bucket to work on aerial cable.

Technological developments during the early and mid-1950's reduced the skill requirements for cable splicers, and practically eliminated the job of cable splicer's helper. Mechanical aides, such as sky buckets, and lightweight equipment began to be widely used. New types of wire pair identification and terminal equipment that made cable splicing possible without tone-testing and without reopening the cable were introduced and accepted throughout the industry. Dehydrator and air pressure equipment, used in the field to keep cable dry and maintained by cable splicers, was moved to the central office. The development of polyethylene eliminated the necessity to sheath a cable with lead. Waterproof polyethylene was substituted for paper wire wrap and the cable splicer no longer required the skills of a plumber to seal a cable. The use of PIC cable (wire insulated with polyethylene) quickly spread and color coding of it enabled the splicer to simply tie together similarly-colored wire or to terminate the wire on an appropriately coded terminal without the need for tone-testing. Terminal equipment was also simplified with the introduction of "ready-access" terminals and the worker could easily enter the terminal box. Indications are that new technologies have been responsible for a 20-percent reduction in cable installation and maintenance time. The need for cable splicers has also been affected by developments which reduce the need for additional cable, such as the rapid growth of microwave transmission for intercity telephone calls, and improvements in carrier technology (permitting a single pair of wires to transmit many conversations).

Linemen have also been greatly affected by recent changes in technology and operating methods. The most important development affecting this occupation is the growth of microwave transmission. Because microwave facilities involve no cables, wires, or poles, their construction requires no linemen.

Telephone lineman installs ready-access terminal equipment.

Other technological developments affecting linemen include new types of laborsaving construction equipment, reducing the amount of hard labor formerly associated with this occupation. For example, during the 1950's a special plow which dug a trench, placed cable and covered it—all in one operation—became widely used. Helicopters were used for the first time to quickly transport poles to a location which might otherwise take days to reach. Earth-boring machines were used to simplify the job of digging holes for telephone poles. The introduction of prelashed and self-supporting cable has also reduced the time required to install new lines.

Despite the overall decline of line, cable, and conduit craftsmen many new workers have been hired to replace those who are promoted or who leave for other reasons. To meet the need for these craftsmen companies hire physically fit high school graduates with training or knowledge of basic principles of electricity. Newly hired persons are given a few weeks classroom instruction where they work under simulated conditions. The skills of experienced workers are constantly being updated to reflect new technologies and methods of operation introduced by the industry.

Clerical Workers

Technological developments have reduced the need for clerical workers despite tremendous expansion of telephone company business. Thus, employment of clerical workers which increased sharply during the first half of the 1950's, from 112,000 in 1950 to a peak of 162,000 in 1957, is currently at a level of 147,000. Nearly all of the decline was for accounting clerical personnel, which dropped by about 10,000. Whereas in 1956 these workers were 29 percent of all clerical workers, they were about 24 percent in 1965.

The decline in accounting clerical personnel

stems mainly from the use of automatic switching equipment which automatically records information about a long-distance call and the use of computers for automatic billing. This equipment was first introduced in 1956 and its use has spread rapidly since.

Persons in many different office occupations—all at essentially the same level of skill—are included in the clerical worker category. The occupations are similar to clerical occupations in other industries throughout the economy: Typist, secretary, receptionist, payroll clerk, and key-punch operator. Although information on the number employed in all occupations in the category is not available, partial information indicates that the leading occupations—in which employment totals about 10,000 each—are secretary, typist, bookkeeper, office machine operator, and clerical supervisor.

Nearly all clerical workers are employed in one of four departments: Accounting, plant, commercial, and traffic. About 25 percent work in accounting, where they prepare payrolls and customer's bills and record revenues and expenses. These workers also prepare financial data required for regulatory commission records, and dividend checks and other materials for stockholders.[3] A nearly similar number work in the plant department, keeping records on maintenance of buildings, equipment, and motor vehicles, and the disposition of company equipment such as cables, wires, and telephone stations. The commercial department employs 18 percent of all clerical workers to keep records, such as those for sales or service, bill collections, and market surveys in connection with customer relations. About 15 percent are employed in the traffic department, where they maintain records in connection with customers' calls and the administrative ordering of equipment. The remaining 13 percent are distributed among other departments such as engineering.

The Bell Telephone Company of Pennsylvania provides an excellent example of the effects of technology on the number of accounting clerical workers needed. Since the use of computer equipment in billing and collecting operations started in 1960, accounting employment declined from 2,400 in 1959 to 2,000 in 1963, despite substantial increases in business. Experiences at the New Jersey Bell Telephone Company are similar. The demand for accounting clerical workers declined by nearly 600 during the 1959–65 period while electronic data processing equipment was being introduced.

Reductions in the number of clerical workers was accomplished mainly through attrition. According to telephone industry estimates, about one quarter of all clerical personnel leave their jobs every year. Of these, about 20 percent move to other jobs in the company and the remainder leave the company. Job shifts are accomplished after training workers both informally on the job and through formal classroom sessions. For example, an estimated $1 million was spent by A.T. & T. in 1 year on off-the-job retraining of accounting clerical workers.[4]

[3] In recent years, within companies using some sort of electronic data processing equipment, activities of the accounting department have been broadened to include many of the computer-oriented functions.

[4] Paul A. Gorman, executive vice-president, American Telephone and Telegraph Company, *New Views on Automation* (Washington: Joint Economic Committee, Subcommittee on Automation and Energy Sources, 1960) p. 265.

3

New Technology and Its Employment Impact

The outlook for the telephone industry in the United States is one of widespread growth, significant technological change, and the introduction of many new telephone services. By 1975, technologies and services which today exist only on a very limited scale will be commonplace. Electronic central offices will provide customers with convenient, faster, and more flexible services. Satellite and other new transmission techniques will increase the coverage and capacity of the international telephone system. New central office equipment will assist the operator in handling calls. New installation and repair techniques will facilitate the service worker's task. All of these innovations bring about changes in job content and in the occupational distribution within the telephone industry. This chapter discusses these new technologies, projects their probable rate of diffusion by 1975, and examines the probable effects of the new innovations on manpower. In addition, the chapter discusses other widely publicized technologies currently only in the laboratory research stage but likely to be introduced shortly after 1975.

Certainly not all of the different technologies that will be placed into service between now and 1975 can be anticipated. Many small technological improvements in equipment and tools used by telephone industry workers will certainly be introduced without any long research and development phase. Although any one of these improvements may be relatively minor, the sum total of these technologies could have significant effects on manpower demand. The technologies discussed in this chapter, however, are believed to be those which will have the most far-reaching manpower implications.

This discussion of technological change and the related employment projections appearing in the next chapter are based on certain assumptions

about the national economy.[1] On the basis of these assumptions, very significant increases are projected in telephone industry activity. The number of telephones in operation in 1975 will be nearly 145 million; the total number of conversations in 1975 will be nearly 195 billion (as compared with 112 billion in 1964); and toll calls, which numbered 4.3 billion in 1964, are projected to increase to nearly 9 billion by 1975. (Behind this projection is the assumption that bulk service authorization will continue to be provided.) Also assumed is an expansion of community antenna TV systems although operating telephone companies may not share in all of the growth of this service. Other measures of telephone industry activity, which in the past have exhibited close correlation with the employment level in large occupational categories (such as miles of telephone cable and workers who install and maintain this cable) are expected to show similar growth. Even more rapid growth will occur in telephone industry services introduced in the early and mid-1960's. By 1975, data transmission will probably amount to a significant portion of telephone industry activity and will be responsible for generating large numbers of jobs.[2]

Significant Technological Changes, 1965–75

The telephone industry will introduce many technological changes throughout the coming decade, although, as in the past, the spread of them throughout the industry will be slow. There are some formidable economic barriers to the wholesale introduction of a technological change. One of the barriers involves the availability of capital funds for investment in new production facilities. For example, the Bell System anticipates that it would cost over $12 billion to completely changeover its central offices to electronic switching. Another is the risk in "freezing" production techniques by large expenditures for capital equipment while new processes are still in a period of dynamic change and development. The reliability of a new system must be proven under all sorts of conditions. For example, Bell System specifications require some equipment to have an expected life span of 40 years before it will be placed into service. Accordingly, the changes resulting from technological developments will more likely be introduced on an "evolutionary" rather than a "revolutionary" basis.

Seven specific technological developments are expected to be introduced during the coming decade and have significant manpower impact. These are grouped into the functions or services they will affect and are:

Technology Affecting Transmission
1. Communications satellite

Technology Affecting Switching
2. Electronic central office (ECO)

Technology Affecting Operation
3. Traffic service position
4. Automatic intercepting
5. Semiautomatic information service

Technology Affecting Installation
6. Dedicated plant

Technology Affecting Clerical Operations
7. Automatic data processing

A description of each technology, together with a discussion of the probable effect on manpower and the speed with which the industry is expected to put the technology into service, follows:

Technology Affecting Transmission

The most important development which will affect transmission by 1975 is the communications satellite. Other developments are also expected to be placed into service during the coming decade, but their effects will be far less revolutionary and their manpower effects probably will be limited. For example, components previously available for limited commercial application (e.g., the transistor) have been sufficiently improved to allow the telephone industry to use them in its transmission equipment. Also, a new form of stormproof, economically installed aerial cable with telephone wires and supporting strand all sealed in a single packet and a new system for keeping moisture out of cables will have some impact on transmission technology. The major effects of these and other developments will be to further lower the cost of telephone circuits, provide uniform performance

[1] See Introduction, page 1, for a statement of the general assumptions.

[2] A significant assumption behind this projection is that the Bell System will be permitted to carry on its data transmission activities. Western Union and other nontelephone companies have proposed that the Bell System be excluded from this area.

throughout the world, and increase the speed and quality of telephone service.

It is anticipated that communications satellites will be used extensively in overseas communications service by 1975.[3] It is estimated that about 50 percent of the 70 million overseas telephone calls that will be made in 1975 will go through communications satellites and by 1980 this proportion will increase to two-thirds. (About 6 million overseas calls were made in 1964.) When a full-scale commercial communications satellite system becomes operational in the next few years, it will make available service to parts of the world which previously had little or no service and will greatly expand the volume of overseas calls.

As has already been mentioned, the telephone industry has been using microwave circuits for a number of years. Ordinarily, microwave transmission is used for line-of-sight transmission. Over-the-horizon microwave transmission (in which the signal is bounced off the atmosphere) also is practical in certain circumstances, such as between Florida and the Bahamas, but generally has severe limitations. Scientists have long recognized that a microwave signal could be beamed at a satellite orbiting the earth, and relayed to a given point on the earth's surface, thus making microwave transmission practical for communication among the continents. Although the use of communication satellites has been discussed since the end of World War II, it was not until the early 1960's that modern rocketry and miniaturized circuitry made this development possible. (See figure.)

The commercial communications satellite system in use in 1975 is likely to be composed of synchronous or stationary satellites. Such a system will likely utilize three satellites, orbiting at an altitude of about 22,500 miles in fixed positions above the equator.

The manpower effect of communications satellites will result mainly from the increased volume rather than from the technology itself. The satellite will find increasing application in the telephone industry. Employment of workers connected with the industry—particularly employment of telephone operators—will increase as a result of the increased volume of overseas calls.

[3] Although it will be technically possible for shorter distance, domestic telephone service to be handled through communications satellites, it is anticipated that the satellite will be limited to overseas transmission by 1975. However, at some future date demand for certain services coupled with new technology in the satellite communications field may justify domestic application.

Technology Affecting Switching

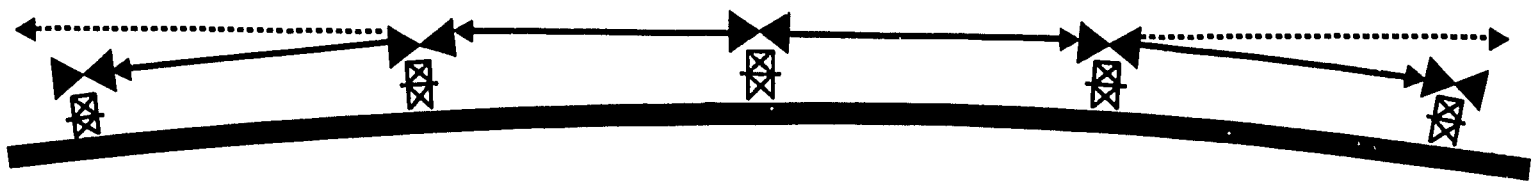
The electronic central office (ECO) promises to be more revolutionary to the telephone industry than any other technology that will be introduced in the next decade. It will meet the demand for increasing telephone service and also speed up this service and provide services to the public that are not now available. This system will gradually replace older switching equipment in central office exchanges and will significantly change central office maintenance requirements.

The transistor is at the heart of the control of the ECO. It completes a switching operation in a millionth of a second instead of the thousandth of a second required with mechanical equipment. The memory unit represents the other major change introduced in the ECO. Whereas equipment currently used has separately wired circuits as a memory unit, the memory in the ECO takes the form of plug-in aluminum cards. In order to change the instructions of the ECO a different card is inserted. This was previously a major rewiring job.

The performance of the ECO is similar to that of a high-speed, general purpose computer with a stored program. Very simply, when a telephone call is placed, a central control coordinates information available in a temporary and permanent memory with instructions given it by the dialer in the form of electrical tones or pulses. However, although the ECO performs in much the same way as a computer, it is far more complicated than the typical computer. For example, the ECO to be used by the Bell System, known as the electronic switching system (ESS), has about a million components whereas a modern IBM computer has roughly one-fifth that many. The central control of the ESS has about 45,000 diodes, 13,000 transistors, 35,000 resistors, 225,000 soldered connections and 56,000 connector terminals. Yet, despite its complexity, the ESS has been designed so that the total downtime of the system will not exceed that of earlier switching systems, i.e., it will not exceed a total of 2 hours during the anticipated 40-year life of the central office.

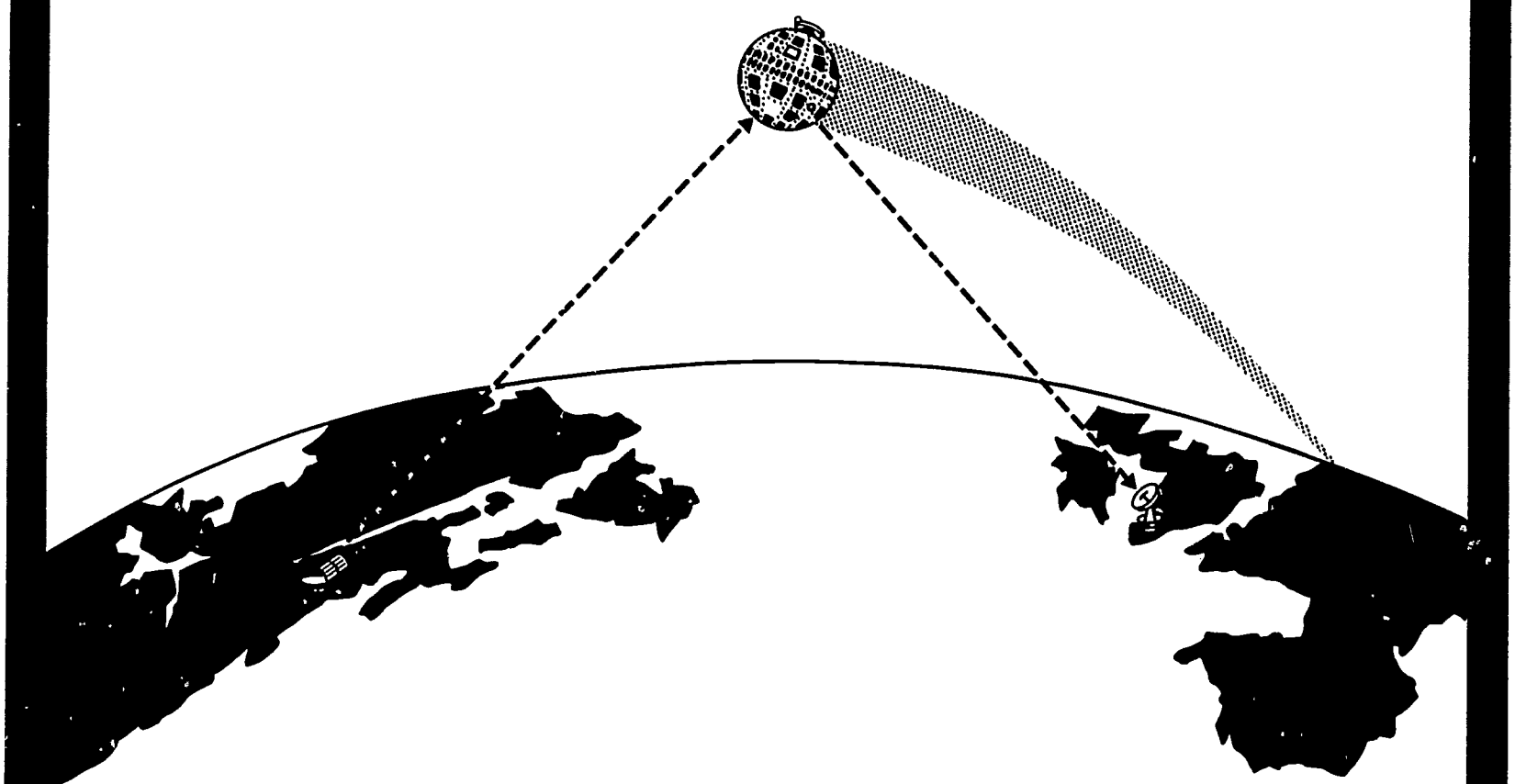
The ECO will make possible many new services that will facilitate business and everyday life. For example, subscribers serviced by an electronic central office will be able to reach frequently called local and long-distance numbers by dialing 2 digits instead of the customary 7 or 10. It will be possible to automatically transfer incoming calls to another

The communications satellite system



Curvature of the earth requires microwave towers to be about 30 miles apart

Microwaves sent via an orbiting satellite can travel vast distances



Source: Ronald M. Foster, Jr., Bell Telephone Laboratories, Satellite Communications Physics, 1963

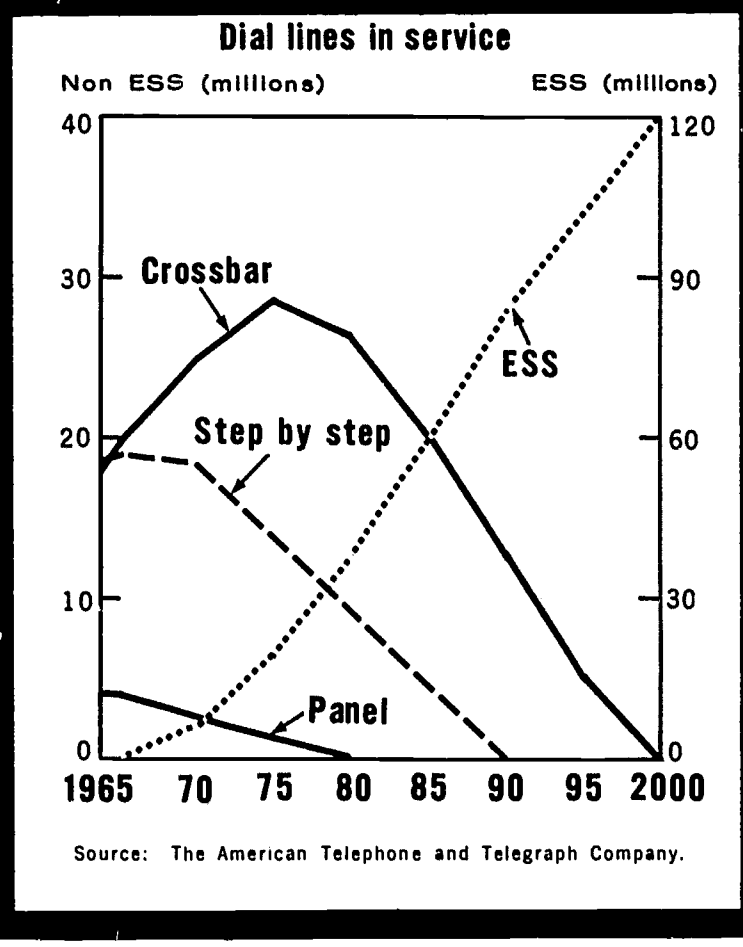
number. Home extension phones may be used as an intercom system. Conference calls between three or more persons on different telephone lines can easily be arranged and additional parties can be brought in after the conference has started. Also, the person with a busy number can be notified

that another call is waiting. The telephone may be used as an alarm clock to ring at a predesignated time; or it may be programed to serve as a timer to turn on or off electrical appliances. Although some of these services could be arranged with conventional switching systems, the ECO may make them truly economical.

Significant numbers of telephones will be connected to electronic central offices by 1975,[4] *although every telephone will probably not be served until the end of this century.* According to estimates prepared by A.T. & T. ESS will grow rapidly in the Bell System after the introduction of the first installation in mid-1965. About 11 percent of the dial lines will be served by an ESS station by 1970, and by 1975 this proportion will increase to nearly 30 percent. Between 1975 and 1980, ESS will replace crossbar equipment as the principal switching system within the Bell System. Growth of ECO will be much slower outside of the Bell System. However, because of the relatively small number of lines served by this sector, the proportion of the total number of lines served by the ECO by 1975 will not be significantly below the 30 percent forecast by A.T. & T. (See chart 3 which projects numbers of lines in service using ESS equipment compared to those using non-ESS—crossbar, step-by-step, and panel equipment.)

Indications are that the ECO will tend to reduce the number of central office workers, particularly central office craftsmen, required by the industry. Several features characteristic of the ECO will facilitate repair and maintenance operations. Duplicate circuits permit the ECO to operate despite a minor breakdown and a repair can be deferred for a brief time. The system is programed to automatically detect and report malfunctions, perform routine tests, and to automatically work around faulty components. If a breakdown occurs, the defective unit is diagnosed by a typewritten print-out in code form. Maintenance workers translate this into repair instructions by referring to a "maintenance dictionary". Modular assembly of the ECO allows the maintenance worker to simply unplug the defective part and plug in a new one. After the repair has been completed, the ECO will automatically test the new circuit. Telephone experts estimate that the majority of the anticipated breakdowns can be handled in this manner. Other breakdowns

Chart 3 Planned introduction of electronic switching in the Bell System, 1965–2000



Source: The American Telephone and Telegraph Company.

that are not self-diagnosed by the machine will require that maintenance personnel be familiar with electronic principles and circuit analysis.

Some maintenance and repair operations on the ECO are expected to be simpler and less intensive than comparable work on other kinds of switching systems. However, because companies have little actual operating experience with the ECO, the precise laborsaving effect cannot be determined. To perform repair operations, not involving the self-diagnostic system of ECO, central office craftsmen will probably be required to have knowledge of the principles of electronics and electricity beyond the knowledge required of craftsmen serving other types of equipment.

Technology Affecting Operation

Telephone operators comprise the telephone industry's largest occupation. Thus any technology

[4] In addition to telephones served by fully electronic offices, additional central offices will have some of the components utilized in the ECO which make possible the new services previously described.

Central office craftsman uses maintenance dictionary to check operation of ECO.

affecting this occupation is especially important in a manpower sense. It is necessary to study the occupation carefully because it is an important source of employment for young, untrained girls and any severe effects caused by the technological innovations could have a significant impact on female employment opportunities.

Just as past changes in technology and operating methods have been aimed at the largest blocks of operator-performed services, future changes will also occur in such areas. Thus, the major change during the coming decade will be aimed at further improving long-distance service by increasing the availability of direct-distance dialing and reducing the amount of time an operator spends on a call. Technologies will further reduce the amount of physical effort an operator must expend and will tend to reduce skill requirements for telephone operators.

Industry experts believe that three different technologies affecting operators will be placed into significant use during the coming 10 years: Traffic service position (TSP),[5] automatic intercept, and computerized information service. Each of these are discussed separately below.

By 1975, Bell System officials expect that about 70 percent of long-distance calls will go through traffic service position equipment and by 1985 or shortly thereafter, the conversion from switchboard to TSP will be complete.

The traffic service position is an electronic console which replaces the familiar switchboard. (See photograph.) It allows the operator to control and record all calls which require her supervision. However, the TSP bears no resemblance to a switchboard either in its method of accomplishing the job or in appearance. With the TSP, the call goes through automatic switching equipment instead of through a plug and cord or key system. The appearance of a TSP office will differ considerably from a switchboard office. Instead of long rows of tall mahogany and black switchboards, the TSP office will contain several brightly-colored consoles.

The TSP will increase the number of calls a telephone operator can handle. It reduces the amount of time an operator spends on person-to-

[5] TSP is Bell System nomenclature. A device known as PPCS (Person-to-person, collect, credit card or third-number charge) is about to be placed into service by independent telephone companies. This device differs only slightly from the TSP used by the Bell System.

Placement of the buttons on the TSP console. The lights in the panel show charges for coin calls, as well as the called and calling numbers of telephones.

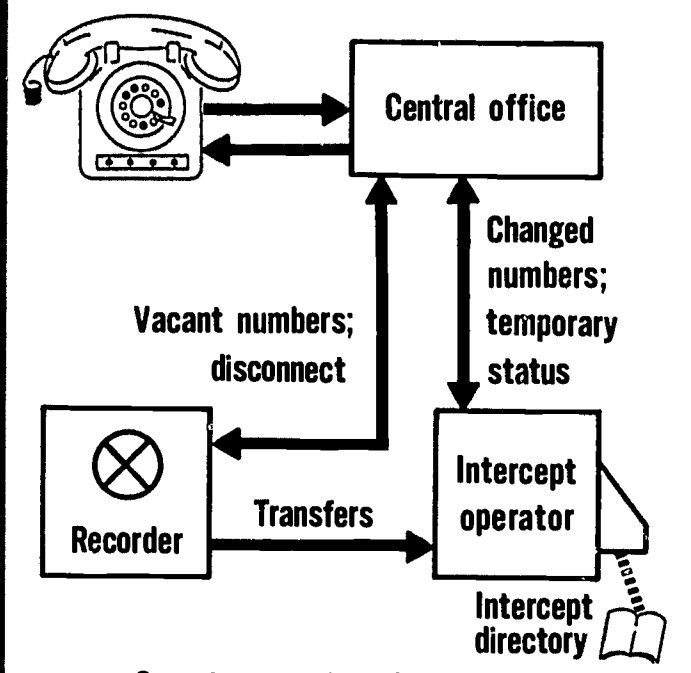
person calls, collect calls, calls charged to a credit card or a third person, and notifying a customer of the time and charges for a call or when he has spoken for a specified period of time. The TSP is capable of reducing the amount of operator time spent on special toll calls by approximately 20 to 25 percent.

Success of the technology ultimately rests with the degree to which the public accepts this method of handling long-distance calls. Indications are that initial acceptance is good and the industry expects that as the public becomes better educated to TSP and gains more experience, acceptance will rise to nearly 100 percent. By 1975, virtually all the traffic offices large enough to use TSP will probably have it in operation.

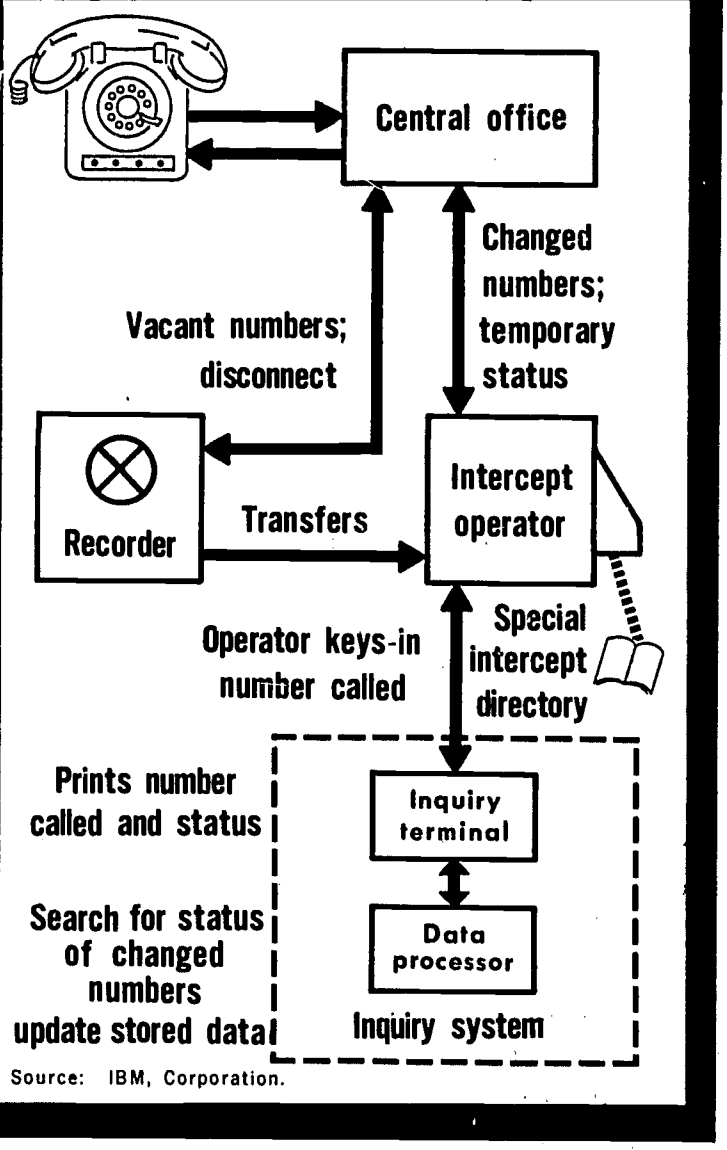
Automatic intercepting can reduce both the number of intercept calls requiring an operator's assistance and the amount of time an operator spends on an intercept call. However, by 1975, use of this technology will be confined to major metropolitan areas. Automatic intercept equipment will probably use either or both an inquiry terminal system, or an audio response system. Under the first alternative, a centrally located computer will store information of the type found in today's directory. In the future, when an intercept call is routed to an operator, the called number will be obtained from the customer and keyed into a terminal. The computer will indicate why the party cannot be reached and provide the new numbers and will relay the information to the caller. Using such a system, the total amount of time an operator spends on an intercept call will drop from the around 30 seconds currently required to about 20 seconds. The audio response system will store the type of information found in an intercept dictionary in a form capable of yielding an appropriate spoken response. The response, unlike a continuous recording, is composed from a stored vocabulary and can furnish virtually the same information that an intercept operator currently supplies. The operation of the audio response system involves a minimum of telephone operator time. Once she ascertains the number being called and keys the number into the computer, the telephone operator is ready for another intercept call. (See chart 4.)

The first automatic intercept system with audio response was installed in St. Louis, Mo. in early 1965. This installation was made mainly as a demonstration and to test operating equipment and public reaction to automatic intercepting. Although

Chart 4 Current intercept system



Automatic intercept system



Source: IBM, Corporation.

it is difficult to determine the acceptability of the system at this early date, it seems probable that automatic intercepting will spread slowly throughout the time period 1965–75. It also seems probable that the telephone industry will place most emphasis on improving long-distance service by introducing TSP equipment.

It is not expected that automatic intercepting will affect employment opportunities for many telephone operators by 1975, despite the laborsaving potential of the technology, because intercept operators account for only a small part of the operator force. Beyond 1975, impetus for the growth of automatic intercepting will stem from anticipated larger than proportional increases in intercept calls. After 1975, anticipations are that automatic intercepting will spread rapidly and by 1980, most large cities will probably have some form of automatic intercept system.

Semiautomatic information service will provide quicker service by reducing the average amount of time an operator spends on an information call (currently around 45 seconds). Information service is now provided from directories very similar to those found in homes and offices. In addition, daily updated directories and in some cases directories containing telephone numbers associated with street addresses are used. Preliminary design of the semiautomatic information system calls for an electronic memory to store the same information now available in these telephone directories. When a telephone user asks for telephone information, the operator will key into a processor the letters or digits representing the first few letters of the name and street address of the person whose phone number is requested. The processor will immediately provide all listings fitting the request. The operator will select from this short list the specific listing which answers the caller's inquiry and provide the phone number. The operation of such a system will provide significantly faster information service and reduce the amount of time an operator now spends on an information call by about 20 to 30 percent.

Although a semiautomatic information system is not now available for technical reasons, leaders in the industry expect that once available the installation of such a system will proceed gradually, starting in the larger cities. The same barriers to rapid introduction and diffusion of automatic intercepting are expected to work against early adoptance and widespread use of computerized information; technical difficulties must be overcome and capital resources will probably be devoted to long-distance service.

Technology Affecting Telephone Installation and Repair

Ultimately, all of the technologies described earlier will be apparent to the telephone customer as he makes daily use of his telephone instrument. However, no group of technologies will be as closely related to the subscriber—yet at the same time less apparent to him—than those technologies relating to the installation and repair of telephone instruments. Some of these technologies will have significant manpower effects, although not as significant as technologies involving switching, transmission, and operating. Others, such as the pushbutton telephone, will probably have no impact on manpower.

In addition to being affected by new technologies, telephone installers and repairmen will continue to be greatly affected by technologies which spread rapidly during the 1950's and 60's. For example, the practice of prewiring buildings and homes for telephone service is now almost completely accepted. In the future, as telephones in buildings and homes containing prewiring grow in proportion to total telephones, the impact of prewiring on the employment of installation workers will probably be even more severe because of the speed with which telephones may be rearranged. This impact will take the form of both decreasing numbers of installation workers required and the skill on their part necessary to properly perform the work.

Dedicated plant is expected to be the technology that will most significantly affect installation and repair occupations. However, other technological developments such as improvements in tools, equipment, and operating procedures will continue to be made during the coming decade and will affect telephone installation and repair occupations.

Dedicated plant will continue to spread rapidly and tend to reduce the demand for telephone installers, central office craftsmen, and construction workers. This plan refers to the permanent assignment and attachment of wires to each actual and potential telephone location. The wires connecting the instrument to its control point in the central office are permanently associated with all service provided to the location. In the event service is not requested, wires are left installed but disconnected from the central office switching equipment. Manpower sav-

Prewiring for telephone service at the time a home is under construction can assure fully concealed lines and adequate outlets in each room for use of extension telephones.

ings stem from the ease with which telephone service may be provided once the wires and cables are installed. Savings also stem from making all adjustments at the central office without visiting the subscriber's home (unless telephone rearrangement is necessary). Also, because the number of wires and connections associated with service is reduced, trouble can be isolated easily and quickly, and chance of human error is minimized.[6] Other advantages of dedicated plant include faster installation and rearrangement of telephones when required.

The outlook for the next decade is for the continued implementation and conversion to dedicated plant. In the past, growth of dedicated plant stemmed from the growth in the number and percent of homes with telephones, since permanent assignment of wires is practical only if a very high proportion of the homes in any particular area can be expected to request telephone service. Future increases in these variables will occur in the years ahead. Use of dedicated plant is expected to be particularly rapid in telephone companies serving rural communities because, although the proportion of rural homes with telephones has traditionally been small compared with that of urban homes, this proportion is increasing more rapidly in rural areas.

[6] B. E. McNee, "Dedicated Plant," *Telephony*, November 23, 1963, p. 96.

Technology Affecting Clerical Operations

The use of automatic data processing, including extensive use of computers, will increase rapidly during the next decade. This increase will be most marked in applications to functions for which computers have been used to only a limited extent in the past, such as supply and equipment ordering, and engineering studies. However, telephone companies which currently use electromechanical accounting machines or small computers for accounting and billing purposes will install large data processing computers for this purpose in the next decade.

In the past, the telephone industry has proven itself willing to experiment with computer applications and, once they have proven successful, the equipment has been quickly adopted. The Bell System installed its first computer in 1958 and by 1964 over 400 computers were being used to perform 14 functions, some on an experimental basis. However, about two-thirds of the equipment is used mainly for billing and collection. Other functions for which computers are used include service order processing, disbursement, accounting operations, maintenance of personnel records, equipment and supply ordering, telephone directory printing, and administering trunk facilities and construction programs.

Future use of automatic data processing equipment will tend to reduce the demand for workers, although the extent of impact is not measurable. The impact of automatic data processing equipment will fall heaviest on clerical workers, but most other occupation groups will also feel some effect. The availability of automatic data processing equipment is anticipated to lead management to request more and more data, reports, and analyses. Any labor displacement effects of this equipment, therefore, will be offset by increasing requirements for its work.

Significant Technological Changes Beyond 1975

Research work underway in telephone industry laboratories promises further technological changes in the years beyond 1975. The picturephone, helical waveguide, pulsecode modulation, and laser have received much publicity. However, because additional time is needed for further research or because the technological developments can only be economical in the larger, more concentrated markets of the late 1970's or 1980's, it is apparent that at least 10 years will elapse before the developments will be applied on a large-scale commercial basis.

Integrated circuits will one day replace transistors, diodes, and other components in electronic switching systems and repeater devices, although this technology will certainly not be introduced before 1975. The effect that integrated circuits will have on industry employment, however, is impossible to predict at this time. Technologies considered in detail here are picturephone, laser and helical waveguide transmission, and centralized computer information service with an audio response.

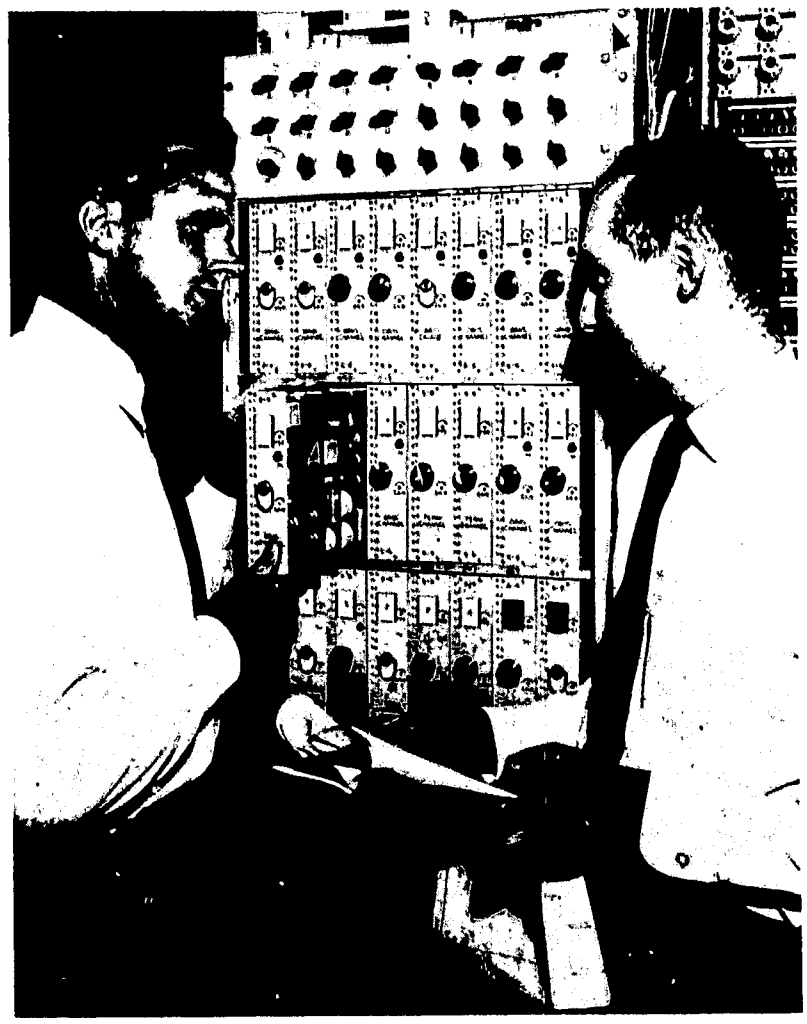
Although picturephone is currently providing visual and audio contact on a demonstration basis from single points in three cities, it is not expected to become widely available for at least a decade. The barriers to early introduction are many, including very high cost. A single picturephone link requires the equivalent of about 125 conventional telephone channels and the rate of cost for a call ranges from $8.00 for a 3-minute conversation between parties in Washington and New York to $13.50 for a 3-minute call between parties in New York and Chicago. Another barrier to widespread adoption of this development is that considerably more microwave and coaxial cable facilities must be constructed to provide the large number of circuits needed. Consequently, industry experts believe that the use of picturephone will grow very slowly through 1975. In the years ahead, laboratory research will probably result in comparable picturephone service with the use of fewer channels. Also, use of pulsecode modulation and satellite transmission in the next 10 years and the introduction of helical waveguide and lasers (both to be discussed later) after 1975 will provide increased transmission facilities and declines in picturephone costs. When it becomes possible to place new transmission technologies into service (probably sometime after the mid-1970's), picturephone will become more economical and its use will increase rapidly.

Picturephone service is not expected to become common until after 1975.

The employment impact of picturephone will probably fall on two groups of workers: those who install and maintain telephones and those who modify, maintain, and repair central office equipment. Picturephone will probably tend to stimulate employment among both groups of workers. The installation and testing of the transmitting and receiving instrument is likely to be extremely time-consuming and the modification of central office equipment is likely to also present problems resulting in increased manpower needs and skills.

Shortly after 1975, industry experts believe that the use of pulsecode modulation (PCM) will expand rapidly for long-distance intercity traffic. PCM is currently being used on a limited basis for local communications (distances of from 15 to 200 miles). Its advantage is that it permits more efficient use of transmission facilities. In systems with PCM, the voice waves from 24 channels are sampled in succession at the rate of 8,000 times a second and translated into code.[7] The coded signals are combined on a single channel and transmitted at a rate of about 1.5 million pulses per second. The signals are decoded into actual speech at the other end of the line with very little distortion or noise. Thus, although only a small proportion of a telephone conversation is actually transmitted, the listener is not able to discern the gaps. The principle is similar to that used in motion picture projection in which the impression of continuous motion is obtained by flashing a succession of still photographs. Existing PCM technology permits about twice as many conversations to be transmitted over two pairs of wires as can be carried by using other carrier techniques. By 1975, the industry expects that PCM will be widely used for data transmission and that technology will permit transmission at the rate of 225 million pulses per second.

PCM will probably tend to reduce the demand for line, cable, and conduit craftsmen, and other workers engaged in the installation and repair of coaxial cable and microwave relay systems. In order to provide the millions of additional circuit miles required for future data and voice communications, PCM coding, decoding, and repeater systems will be installed on many existing as well as prospective coaxial cable and microwave systems. However, it appears that the installation of PCM equipment will not require as much effort as does the construction of coaxial and microwave equipment. Offsetting the labor-displacing effect, PCM may cause reductions in transmission costs, thus encouraging additional use of telephone facilities.



Pulsecode modulation equipment will spread rapidly around 1975.

The helical waveguide will make extreme high density, point-to-point transmission possible. Because the waveguide operates at extremely high frequencies, it is capable of carrying more communications than either coaxial or microwave; 100,000 conversations as compared with 3,600 for coaxial and 10,000 for microwave.

The major barrier to the introduction of helical waveguide is the lack of sufficient demand. The first applications of this transmission technology may come shortly before 1975 along heavily used routes as, for example, between New York and Washington or New York and Chicago. However, widespread use of the helical waveguide is not expected until after 1975.

Helical waveguide transmission is accomplished through an underground tube, 2 inches in diameter, filled with gas. Broadband radio waves are trans-

[7] Other multiplexing techniques have been in use on long-distance calls for a number of years. For example, on overseas calls a time-multiplex system is used whereby a communications channel is assigned to a conversation only when speech is actually being transmitted.

mitted using microwave broadcasting and regenerating techniques.

When helical waveguide is introduced, it will probably be used to supplement existing transmission capacity between major cities instead of substituting for microwave and coaxial facilities that now exist. Consequently, the most significant manpower effect is likely to be a reduction in the number of construction workers required because relatively little construction effort is necessary to add tremendous amounts of transmission capacity. The waveguide technology is not expected to cause significant changes in the skills of workers because the system is, in many respects, similar to microwave transmission. The major difference is the wavelength and the transmission medium. It is probable that installation, maintenance, and repairs of the waveguide broadcasting and repeating systems will not be essentially different from similar work on microwave equipment. Also, the installation, maintenance, and repair of tubes used in waveguide transmission, although very different from that for existing wires and cables, probably will not require skills on the part of cable and conduit craftsmen appreciably higher than the present ones.

The cross section of an experimental vertical waveguide tube. Inside surface consists of a finely-wound wire helix which helps filter out unwanted forms of radio energy.

Although the laser offers enormous communications carrying capacity, the industry does not expect to introduce it within the next decade. The very high frequencies provided by a beam of light (laser beam) make it possible to transmit a tremendous number of different signals over a single beam; whereas the optimum capacity of the helical waveguide is 100,000 conversations, a laser beam can carry about 1 billion.

Introduction of laser transmission is not expected until sometime after 1980. The obstacles to rapid introduction of this technology are many. Before laser transmission may be placed into service, many technical problems must be overcome. Also, it is not economically practical until there is sufficient demand for high density, point-to-point communications service which data and picturephone service are likely to eventually require.

The impact of laser transmission is likely to be felt initially by construction workers, who will install the plastic, concrete, or metal pipe used to carry the laser beam. Construction workers will also be needed to install the devices used to amplify, focus, and perform the other technical functions associated with a laser transmission. The impact of the laser will also be felt by workers in occupations relating to telephone transmission. In its early years, laser transmission will require highly skilled workers trained in optical science to maintain and repair the sensitive lenses and other equipment associated with the laser. However, because laser transmission capacity will probably be added slowly to existing transmission capacity rather than used to replace existing cable, microwave, or waveguide systems, skill requirements are likely to change slowly.

The technical possibility exists that sometime beyond 1975 information systems with audio response will be introduced in major U.S. cities. In such a system, telephone numbers would be stored in a processor in a form capable of yielding an appropriate spoken response. Once the approximate spelling and address of the party whose telephone number is wanted is keyed, the computer will search its memory and compose a sentence containing the precise spelling address and phone numbers of parties who fit the description given by the caller. The caller selects the telephone number he wants. If the caller is able to provide the precise spelling and address of the party he is calling, the processor, of course, will provide only one number.

Ultimately, all information service may be provided from one or several centrally located stations in the United States. The widespread use of satellite, pulsecode modulation waveguide, and laser transmission will make available a tremendous amount of inexpensive long-distance circuits. This large supply will be instrumental in lowering circuit costs to a level competing with local transmission costs. Consequently, it may be more economical to provide information service from one centrally located computer.

Certainly it will be many years before it will be possible to place this technology into service. There are no present industry plans to introduce it. Also, it is possible that public antagonism to a totally new information system will preclude its use, and many technical obstacles must be overcome. The problems of programing this equipment with the billions of bits of information, and of allowing thousands of operators to gain access to the information at the same time must also be overcome. However, if this system becomes widely used, it will have considerable employment impact on telephone operators. As has already been mentioned, information telephone calls are expected to continue to grow rapidly. Information work already accounts for 18 percent of telephone operator employment. As the TSP reduces the amount of long-distance service provided by operators, and as automatic intercept grows, this proportion will grow.

4

Employment Outlook, 1965–75

As the discussion in the previous chapter suggests, technological developments in the telephone industry will have an important influence on the industry's manpower. Developments will affect the level of industry employment, occupational structure of the industry, and the nature of work, education, and the skills required of workers in nearly all of the major telephone industry occupational categories. This chapter discusses future employment opportunities in major occupations in the telephone industry, the education and skills required for these occupations, and the way industry will probably meet its needs.

Technology is just one of several variables influencing the level of employment. However, it is of major significance as an influence on skills and the occupational mix. Other factors, such as economic growth, new services, and changing methods of operation have been at least of equal importance as determinants of the employment level. Indications are that future technological change will not grow in importance as an influence on the employment level. The impact of new technology will be offset in many cases by other factors, especially industry growth. Also, no technology on the verge of widespread use promises to have a complete revolutionary impact on a really large group of workers. For example, the most significant development, the electronic central office, will probably have a primary affect only on central office craftsmen—68,400 workers. Other major technologies, such as the traffic service position, give indications of affecting even smaller groups of workers. In contrast, in 1921, when the Bell System introduced its first automatic exchange, about 115,000 operators were employed and were ultimately affected. The impact of changing technology on the employment level will be mitigated also by the gradual rate at which new technologies are expected to be placed into service in the telephone industry. The conversion from manual to dial took six decades. Leading telephone industry spokesmen anticipate a slightly

shorter time interval (four decades) before the conversion to electronic switching is complete. Similar gradual acceptance is anticipated for the other technologies examined.

Employment in the independent segment will grow at a faster rate than in the Bell System and its manpower will be less affected by the developments discussed. Growth in the Bell System will stem almost entirely from general growth of the economy and new telephone industry services. Growth in the independent section of the industry will probably exceed that of the Bell System. The employment projections which follow are probably conservative in relation to the demands of the independent section and liberal in relation to the demands of the Bell System. The effects of technology on education and training needs will also not be the same for the two segments. Generally, the nature of new technology makes its initial use more attractive in areas of high traffic density typical of Bell System operating companies. Consequently, any changes in the nature of the work, skill, and training needs stemming from new technology will be felt first by telephone industry workers in the larger cities.

Telephone industry employment is expected to increase slowly during the next decade. By 1975, 80,000 additional workers will be employed (table 3). However, as will be discussed later, employment of various occupation groups will not grow evenly and some of the employment highs recorded by certain occupations in the mid-1950's may never again be achieved. Growth of telephone industry employment will be much less than overall economic growth, labor force growth, and the volume of telephone industry business. Employment in the industry is projected to increase by about 11 percent between 1965 and 1975 as compared with a projected 56 percent increase in the gross national product, 22 percent increase in the labor force, and 65 percent increase in phone calls.

The overall industry employment projection indicates a reversal of the downward trend that has occurred in recent years. Employment increases were registered in 1964 and 1965 and these gains are expected to continue during the next decade. Further employment growth will stem from the anticipated economic advances expected to occur over the next decade and tremendous expansion of services only recently offered. These advances will more than offset increased efficiency made possible by technical innovation and new methods of operation.

Especially significant in bringing about a reversal of the downward trend in employment is the fact that by 1963 the conversion of central offices from manual to dial had been virtually completed. The introduction of dial equipment resulted in large decreases in the employment of telephone operators, the largest single occupation group. Between 1957 and 1963, the number of telephone operators declined by 74,400 (see table 1),

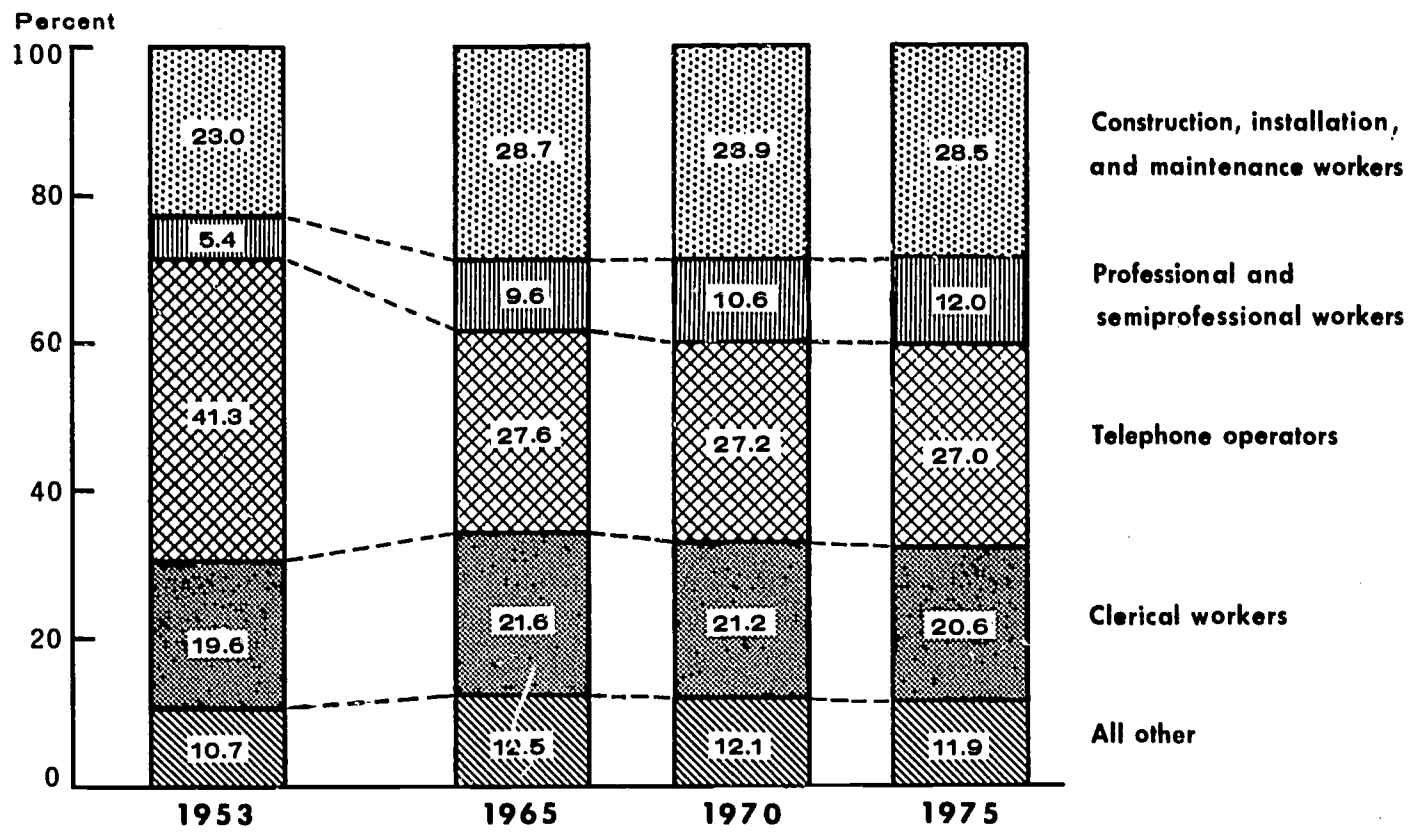
TABLE 3. TELEPHONE INDUSTRY EMPLOYMENT BY OCCUPATION GROUP, 1965 AND PROJECTED 1970 AND 1975

Occupation group	1965[1]	1970	1975	Percent change	
				1965 1970	1965 1975
All groups[2]	736,200	779,000	816,000	5.8	10.8
Telephone operators	203,600	212,000	220,000	4.1	8.1
Construction, installation, and maintenance	210,900	225,000	233,000	7.2	11.0
Telephone installers and repairmen	78,300	83,000	85,000	6.0	8.5
Central office craftsmen	68,400	76,000	79,000	11.1	15.5
Line, cable, and conduit craftsmen	36,300	37,000	38,000	1.9	4.7
All other construction and maintenance	27,900	29,000	31,000	3.9	11.0
Clerical	159,000	165,000	168,000	3.8	5.7
Professional and semiprofessional	70,500	83,000	98,000	17.7	39.0
Business office and sales and all other occupations	92,200	94,000	97,000	2.0	5.3

1 Preliminary.
2 Does not include telephone manufacturing or research activity.
NOTE: These figures are for all telephone industry employment. Charts 6 through 9 refer to class A carrier employment only.

SOURCE: 1965 data from Table 1, page 16; 1970 and 1975 projections by U.S. Department of Labor, Manpower Administration, Office of Manpower Policy, Evaluation, and Research.

Chart 5 Changes in the distribution of telephone industry employment 1953 and 1965 and projected 1970 and 1975



Source U.S. Department of Labor, Office of Manpower Policy, Evaluation, and Research; 1953 and 1965 data supplied by the Bureau of Labor Statistics, and American Telephone and Telegraph Co.

accounting for about 90 percent of the total decline in telephone industry employment during that period. Although technological developments will continue to reduce the number of calls an operator must handle and the time required per call handled, the number of operators is expected to increase during the next decade as a result of telephone industry growth.

The occupational structure within the telephone industry will change slightly by 1975 (see chart 5.) The number of telephone operators and clerical workers will decline somewhat in proportion to total telephone industry employment, while the number of professional and semiprofessional workers will grow substantially. In contrast to past trends, the number of construction, installation, and maintenance workers will increase slightly in proportion to total telephone industry employment during the first part of the 1965–75 period and then remain at a nearly constant proportion in the latter years. More specific trends for these occupations will be discussed later.

The number of women employees in the industry is expected to increase from about 393,500 in 1964 to about 444,300 in 1975 (see table 4). As a proportion of total industry employment, however, the number of women employees will decline slightly, from 55.6 percent in 1964, to 54.4 percent in 1975. This relative decline will be a result of the declining proportion of telephone operators and clerical workers; about 85 percent of all women in the industry are employed in these two occupations.

The industry is expected to continue to hire significant numbers of workers during the years ahead, despite employment growth anticipated to average only about 8,000 a year. Labor turnover for the industry has been quite high (approximately 10–15 percent) and indications are that this trend will continue. The high rate is due mainly to the large numbers of young women employed in clerical and operator jobs. Furthermore, a high retirement and death rate is expected during the coming decade as workers hired dur-

TABLE 4. FEMALE EMPLOYMENT IN THE TELEPHONE INDUSTRY BY OCCUPATION GROUP, 1964 AND PROJECTED 1970 AND 1975

Occupation group	Percent of female employees in 1964[1]	Number of female employees[2]		
		1964	1970	1975
All groups	55.6	593,500	428,800	444,300
Telephone operators	100.0	193,600	212,000	220,000
Construction, installation, and maintenance	0.2	440	480	500
Clerical	92.0	140,300	151,800	154,600
Professional and semiprofessional	21.4	14,500	17,800	21,000
Business office, sales, and all other occupations	49.7	43,700	46,700	48,200
Female employees as percent of total employees	.....	55.6	55.0	54.4

[1] Based on data appearing in *Industry Wage Survey: Communications* (Washington: U.S. Department of Labor, Bureau of Labor Statistics, 1964), Bulletin 1467.

[2] Detail may not add to total due to rounding.
SOURCE: Same as Table 3.

ing the 1920's—a period of rapid expansion of telephone industry employment—reach retirement age. Consequently, rough estimates of attrition indicate that during the 1965–75 period, nearly one million workers, an average of about 85,000 a year, will leave the industry.

Telephone Operators

Employment of telephone operators is expected to increase slightly during the next decade. The growing volume of telephone calls, particularly toll, information, and intercept calls, will more than offset the effects of technological change on operator requirements. Toll calls are expected to nearly double by 1975 and information calls, which numbered an estimated 3.2 billion in 1964, will double by 1970.[1] Developments which will allow a telephone operator to handle an increasing volume of calls will help to offset these factors. For example, further increases in the number of calls that are handled through Automatic Message Accounting (AMA) equipment are expected to occur. The widespread use of the traffic service positions (TSP) will, by 1975, also allow operators to speed up the handling of collect, person-to-person, and other types of toll calls. The limited use of the automatic intercept system and semiautomatic information system will also tend to reduce the need for operators. As a result of these factors, the average number of toll and information calls per operator is projected to double, from nearly 50,000 annually in 1964 to about 100,000 in 1975.[2] (See chart 6.) The rate of increase in the average number of intercept calls per telephone operator is expected to be similar.

Large numbers of young women will be needed for telephone operator jobs throughout the remainder of the 1960's and during the 1970's, despite slow growth in total operator employment. Openings will stem from the need to replace those who leave the occupation. Every year in the past decade about a quarter of all operators in the telephone industry left their jobs. The industry expects to hire about 45,000 operators annually to replace those who leave the occupation.

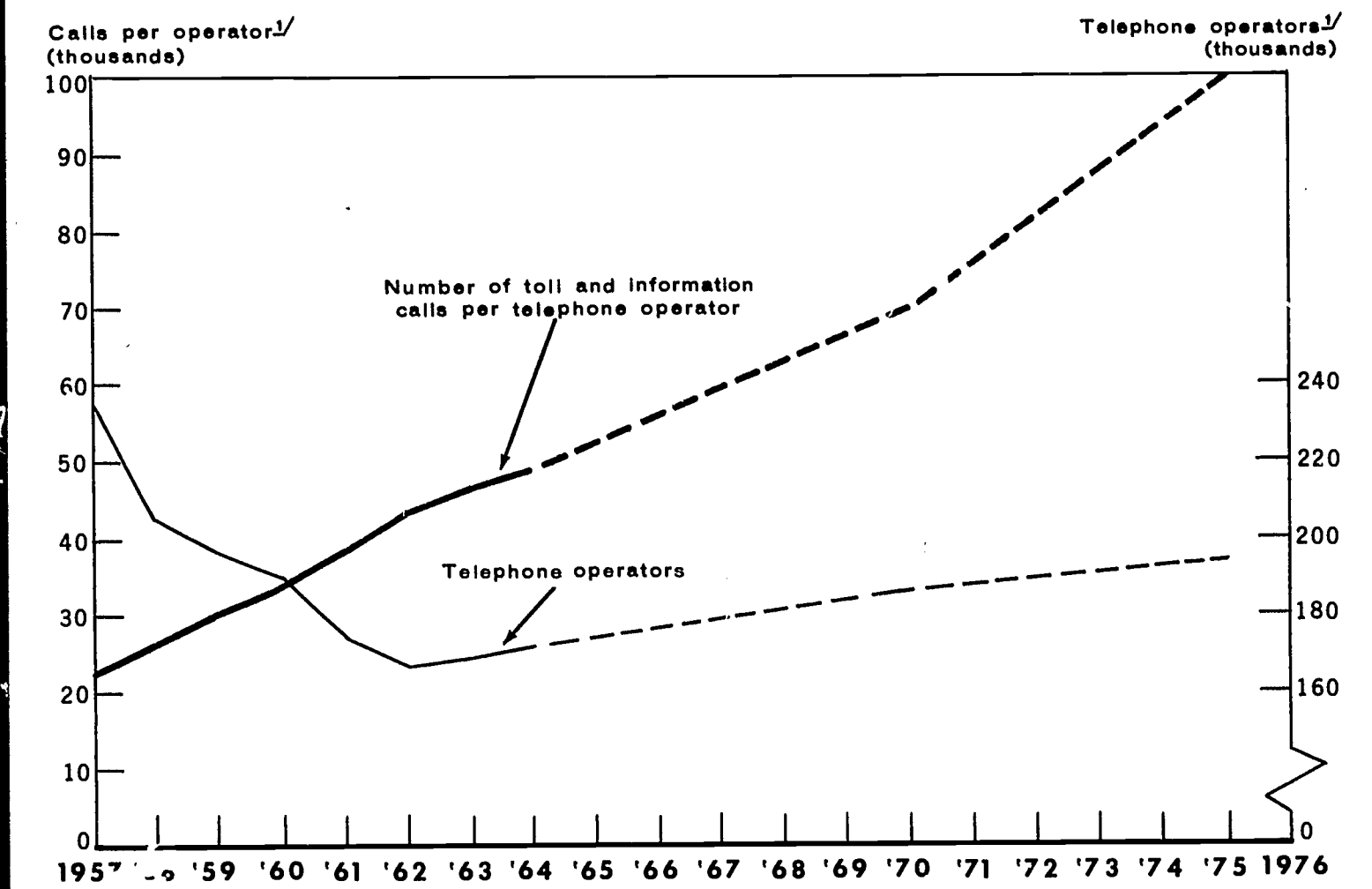
Although the nature of the work of telephone operators will change slightly as equipment changes, the skill level is not expected to change significantly. Thus, although technology and operating methods will probably continue to lessen physical requirements and reduce the number of routine calls which an operator must complete, the future educational and training requirements for jobs as telephone operators are not likely to be any different than they are at present. That is, telephone companies will continue to prefer to hire young high school graduates or college students who can pass an examination that tests the applicant's ability to spell and her learning ability. Once hired, the operator will receive several weeks of training.

[1] Since 1958, calls for information have been the most rapidly growing type of call, increasing even faster than long-distance calls. Reasons for the growth include the increasing size of telephone books and the practice in many cities of splitting a telephone book into many volumes and selectively distributing the volumes.

[2] These projections assume no change in average weekly hours worked per telephone operator (37.2 hours per week in 1964), an assumption based on the apparent stability of average weekly hours of telephone operators since 1950.

Chart 6

Telephone operators, toll and information calls per telephone operator,[1] 1957–64, and projected 1970 and 1975



1/ Data include Class 'A' telephone carriers only.
Source: U.S. Department of Labor, Office of Manpower Policy, Evaluation, and Research; 1957-64 data based on that appearing in Federal Communications Commission, Statistics of Communication: Common Carriers, and from the Bureau of Labor Statistics.

Construction, Installation, and Maintenance Workers

Employment in this category is expected to increase somewhat during the 1964–75 period; however, change will occur unevenly among the leading occupations. Line, cable, and conduit craftsmen will continue to decline in relative numerical importance while other workers, particularly central office craftsmen, will grow.

Central office craftsmen are expected to constitute one of the fastest growing occupation groups in the telephone industry. By 1975, employment in this group is expected to be about 80,000—nearly 10 percent of total industry employment. The major reason for the growth is the expected increase in the number of central offices necessitated by increasing demand for telephone service, particularly in newly settled suburban areas, and greatly expanded demand from businesses for data communications services. Thus, if present trends continue, by 1975 the number of central offices should have increased by about 25 percent, to an estimated 13,100. As a result of technological change, the number of central office craftsmen will not grow nearly as fast as the number of central offices. Several factors will tend to restrict growth. One of the major factors will be the gradual introduction of electronic central offices. The self-diagnosis capability built into the ECO greatly simplifies repairwork. By 1975, estimates are that 20 to 30 percent of central offices will be electronic. Also, other new central offices and many existing offices will be equipped with modern crossbar equipment which will require less maintenance

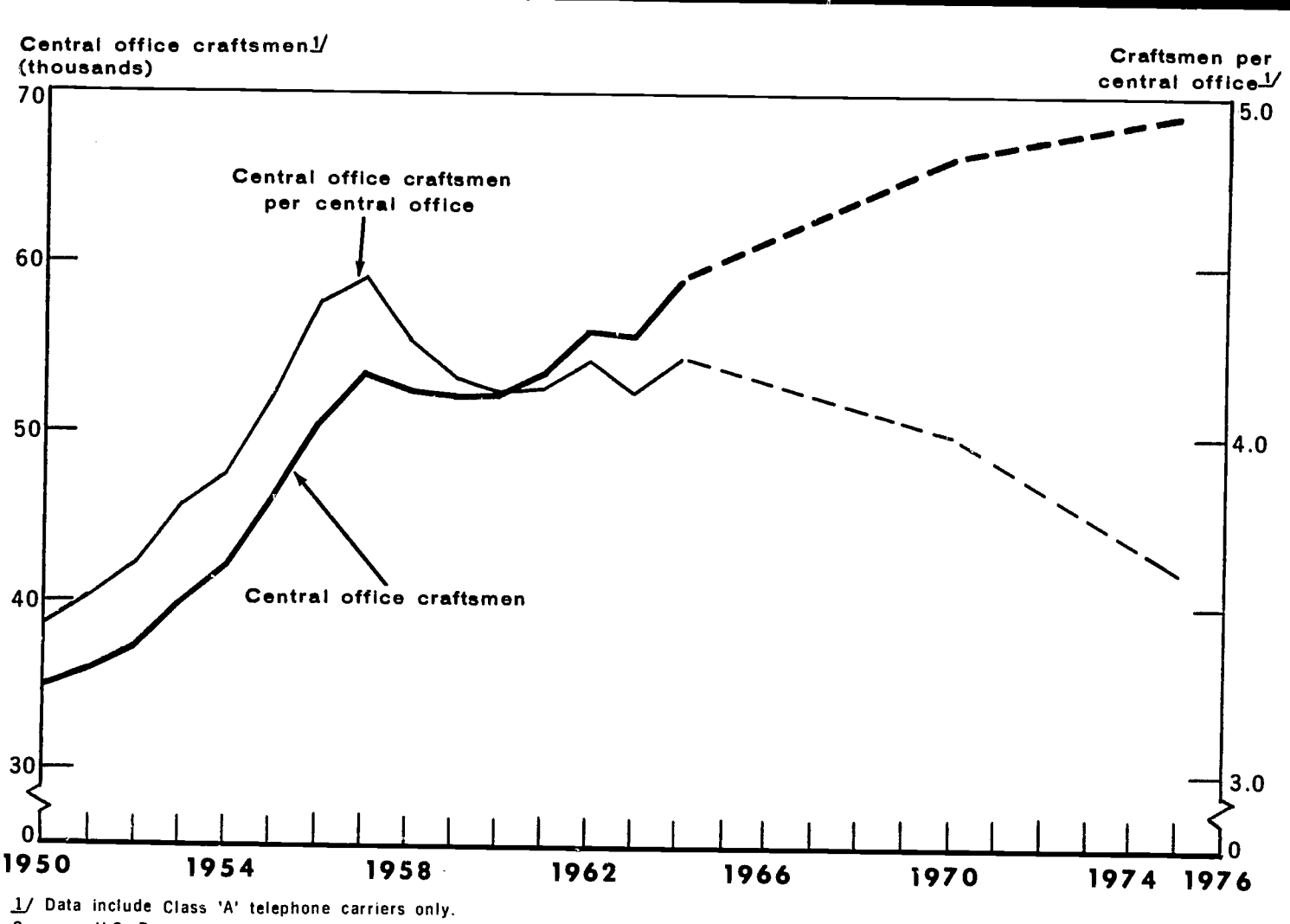
and repairs than older equipment. As a result of these changes, the average number of central office craftsmen in each central office is projected to drop from the 4.1–4.3 ratios typical of the last years to 4.0 in 1970 and 3.6 in 1975. (See chart 7.)

Estimates are that about 5,000 persons will have to be hired each year for central office crafts jobs. An average of nearly 1,000 jobs annually for central office craftsmen during the 1964–75 period will result from growth. In contrast, jobs resulting from the need to replace these workers are likely to be numerous. For example, the Bureau of Labor Statistics estimates that an additional 3,000 workers will be needed each year to replace those who retire or die.[3] An additional thousand or so will be needed each year to replace those who are promoted or leave the occupation group for other reasons.

Technology will also change the nature of the work of central office craftsmen and the skills required of these workers. Greater use of modern crossbar switching equipment is expected to continue to affect the nature of the work by requiring an increasing emphasis on work with electrical circuits and a decline in mechanical work. Electronic switching systems continue this trend and virtually eliminate mechanical parts by replacing them with complex electrical circuitry. However, the vast majority of all repair operations will be easily performed through the self-diagnostic circuits built into the ECO. The net result of the ECO will probably be simplification of routine repair and maintenance operations so that they can

[3] *Employment Outlook In Telephone Occupations* (Washington: U.S. Department of Labor, Bureau of Labor Statistics, 1964), Occupational Outlook Report Series, Bulletin 1375–108, p. 12.

Chart 7 Total number of central office craftsmen and number of central office craftsmen per central office, 1950–64 and projected 1970 and 1975



1/ Data include Class 'A' telephone carriers only.

Source: U.S. Department of Labor, Office of Manpower Policy, Evaluation, and Research; 1950-64 data based on that appearing in Federal Communications Commission, Statistics of Communication: Common Carriers, and from the Bureau of Labor Statistics.

easily be handled by an entry-level worker, and the requiring of very highly skilled technical persons to handle nonroutine malfunctions.

No shortage of central office craftsmen is anticipated. Generally, operating telephone companies will train young high school graduates or transferees from other telephone company occupations for central office crafts jobs. For those highly skilled jobs involving complex repairs in the ECO, telephone companies are expected to retrain persons now repairing the complex circuitry found in crossbar equipment. In time, should the supply of experienced persons able to perform complex repairs be inadequate, companies may seek and train graduates of 2–year technical institute programs with a specialty in electronics. For jobs involving more routine maintenance and repair operations, telephone companies expect to give high school graduates a few weeks of training in this specialty.

Employment of telephone installers, and repairmen will increase slightly toward the end of the 1965–75 period. Over the 10–year period, the number of installation and exchange repair craftsmen will probably increase by about 7,000 to a total of 85,000. Anticipated growth in the number of new telephone installations and total telephones in service and increased use of complex PBX equipment (especially electronic PBX systems modeled after the ECO), will tend to cause employment increases. However, growth will be partially offset by the ease with which a telephone may be placed into service because of pre-wiring, telephones left in place, plug-in telephones, and simplified maintenance and repair procedures stemming from improved components and troubleshooting procedures, and modular replacement of defective equipment. During the first half of the next decade, factors tending to reduce the need for telephone installers and repairmen may enable these workers to increase the ratio of telephones in service per repairman from 1,150 in 1964 to about 1,400 in 1970 and 1,700 in 1975. However, industry growth stemming from increased growth in gross national product and household formation, and accelerated use of relatively complex pushbutton telephones and PBX systems will more than offset this anticipated increase in the number of telephones per repairman. As a result, employment will probably increase slowly during the 1965–75 period. (See chart 8.)

The Bureau of Labor Statistics estimates that more than 3,000 workers will have to be hired annually for this occupation to replace workers who retire or die,[4] and an additional thousand or so will be needed to replace those who leave the occupation for other reasons.

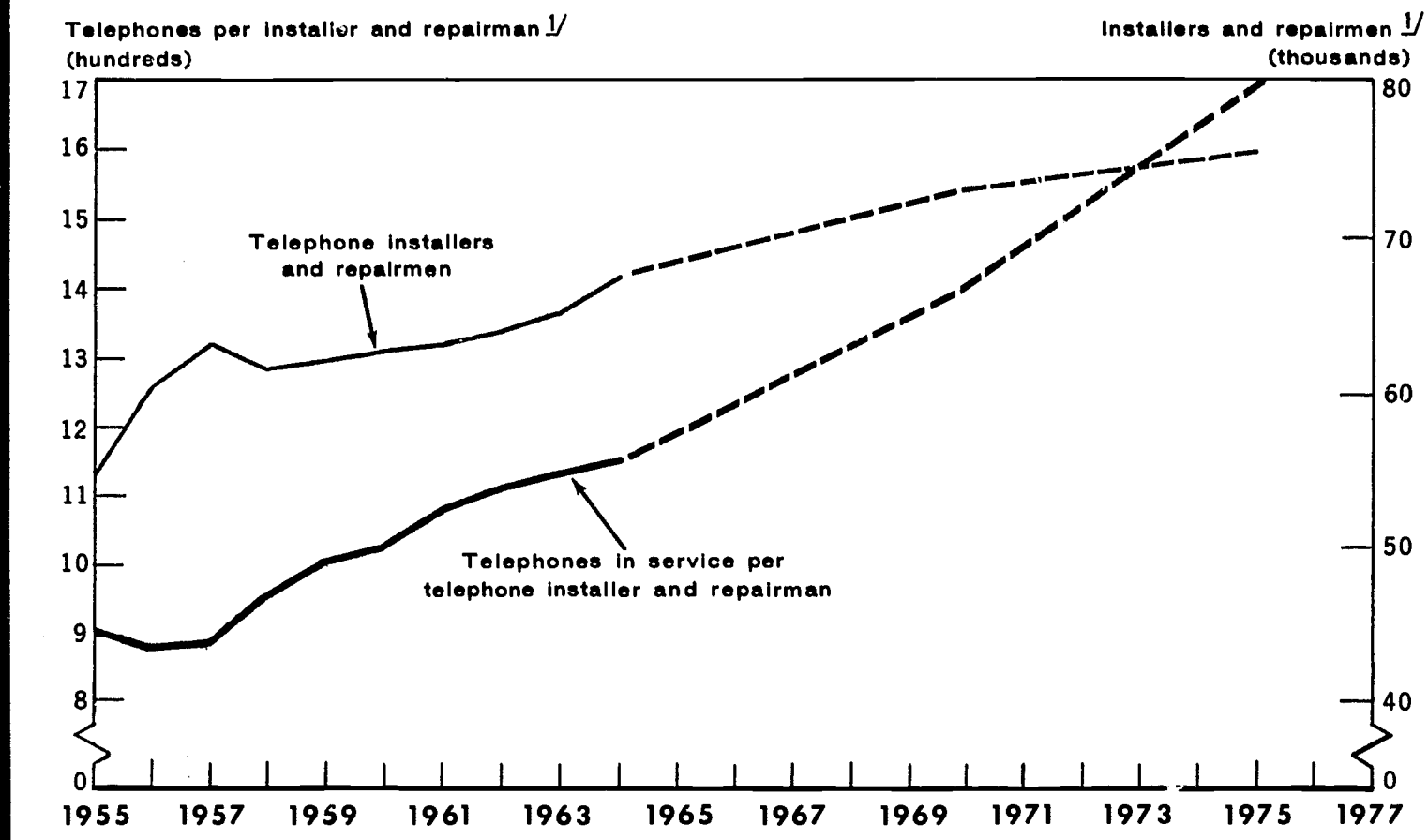
As a result of changes in technology and operating methods, some change in the nature of the work of telephone installers and repairmen is expected. Also, modern electronics has made possible a solid state, electronic PBX. Repairmen who work on this equipment will need training similar to that given central office craftsmen who do nonroutine repair work on the ECO. In fact, because the new PBX equipment will probably be located in or near the telephone company central office rather than in the customer's office or building, some of the work on this equipment may be done by central office craftsmen and the line of demarcation between central office work and PBX repair work may become increasingly blurred.

Telephone companies will continue to resort to traditional methods to meet the need for trained personnel. Young men with a high school education will be hired for entry jobs as assistants to installer-repairmen; they will be given several weeks' classroom instruction and on-the-job training. Gradually, over a period of several years and a combination of on-the-job and formal classroom training, the trainee will advance to the more skilled, better paying jobs.

Employment of line, cable, and conduit craftsmen is expected to grow very slowly. Projections indicate that by 1975, employment in this category will increase from 36,300 to about 38,000 workers. The major reason for this very small growth is the increase expected in the average amount of line and cable that a craftsman can install and service. This increase will stem from further use of PIC cable, ready-access terminals, and color coding and improved construction equipment, and management methods. As a result of these factors, the amount of wire and cable in service per craftsman, which increased by about 60 percent between 1959 and 1963, is expected to nearly double by 1975. An anticipated decline in the rate of growth of the amount of wire and cable in service will also act to reduce the need for these craftsmen. This decline will stem from increased use of microwave transmission, pulsecode modulation, and other comparable forms of time and frequency multiplexing which allow more

[4] Ibid, p. 10.

Chart 8 Telephone installers and repairmen and number of telephones in service per telephone installer and repairman, 1/ 1955–64 and projected 1970 and 1975



1/ Data include Class 'A' telephone carriers only.

Source: U.S. Department of Labor, Office of Manpower Policy, Evaluation, and Research; 1956-64 data based on that appearing in Federal Communications Commission, Statistics of Communications: Common Carriers, and from the Bureau of Labor Statistics.

efficient use of wire and cable facilities. (See chart 9.)

Clerical Workers

The number of clerical workers is expected to increase slowly during the first half of the 1965–75 period. This projection is based largely on a projection of total clerical workers in the economy prepared by the Bureau of Labor Statistics.[5] However, because clerical work in the telephone industry appears to lend itself more readily to electronic data processing techniques than do comparable functions in other industries,[6] the use of computers will grow at a faster rate than in the general economy, and employment of clerical workers will grow somewhat slower.

The use of computers in the telephone industry will continue to grow most rapidly in accounting operations and by 1975, some form of electronic data processing will probably be in use by practically every telephone operating company. Thus, little employment increase of accounting clericals is expected despite the anticipated huge increases in traffic. The use of computers in plant, commercial, traffic, and other departments will proceed somewhat slower, and somewhat modest increases in the employment of clericals will probably occur.

Despite this somewhat slower growth, telephone companies will recruit large numbers of clerical workers annually to replace those who leave the occupation. Throughout the 1965–75 period, more than 30,000 persons, mainly young women who are high school graduates and who have clerical aptitude and training, will be hired each year to replace those who leave the occupation group.

Significant changes are anticipated in the occupational structure of the clerical worker category and the nature of the work of a significant number of clerical workers by 1975, as a result of the

5 "Manpower Needs in 1975," *Monthly Labor Review,* April 1965, pp. 378–383.

6 The Diebold Group, Inc., for Communications Workers of America, *Automation: Impact and Implications With Focus on Developments in the Communications Industry* (Washington: AFL-CIO, April 1965) p. 154.

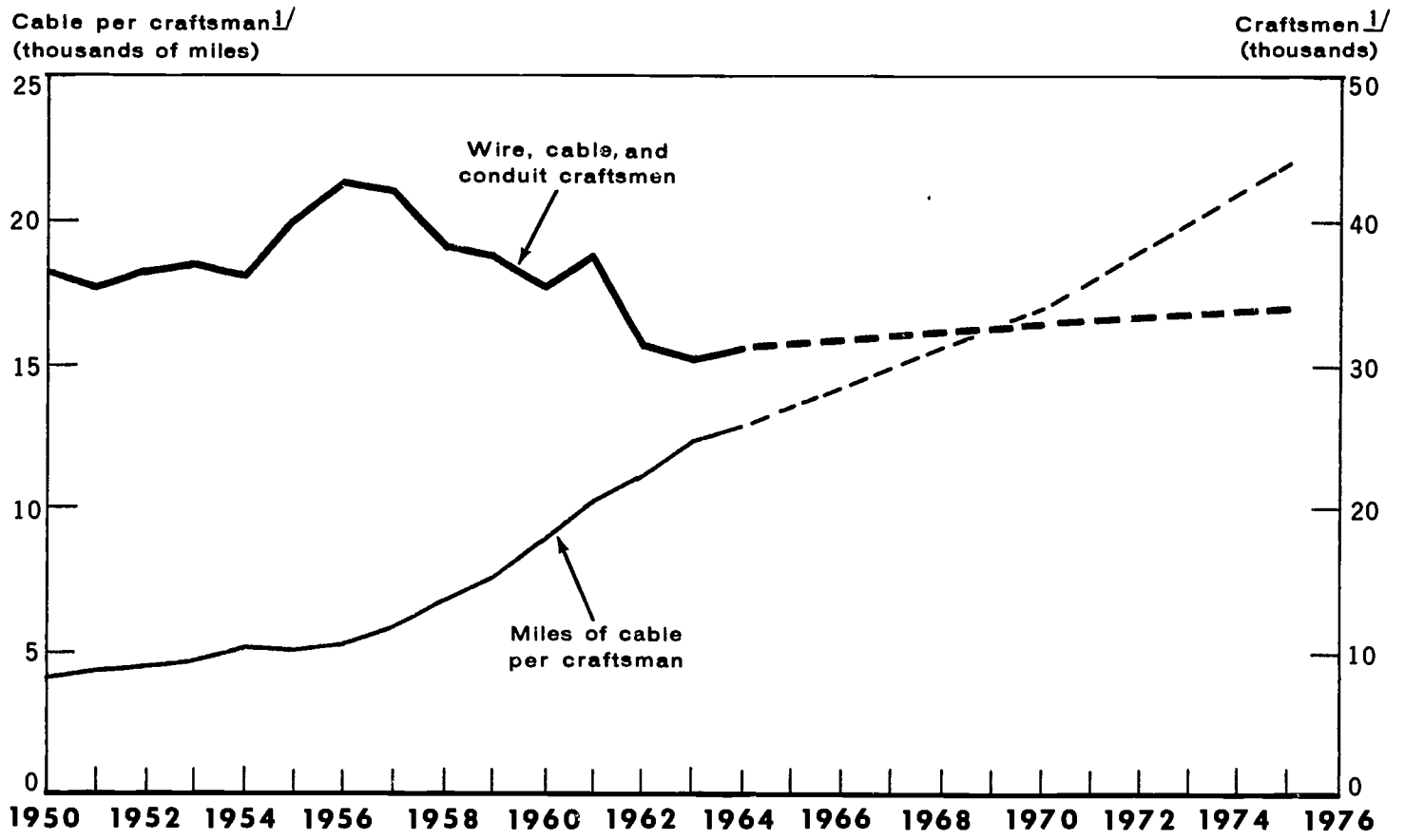
automatic data processing systems discussed in the previous chapter. In general, the impact will be particularly severe on semiskilled and unskilled young office workers of both sexes. The demand for workers for such occupations as clerk, messenger, accounting machine operator, bookkeeper, and file clerk are expected to decline sharply. On the other hand, very large increases in demand for workers in jobs associated with computer programing and operation are anticipated in the years ahead. Employment in occupations such as keypunch operator, EDP machine operator, accounting librarian, and programer are expected to increase significantly over 1965 levels, while employment of secretaries and typists will increase at a somewhat slower rate.

Professional and Semiprofessional Workers

Employment of semiprofessional and professional workers will grow faster than will employment of any other group of workers. By 1975, projections indicate that the industry will employ 98,000 professional and semiprofessional workers. Employment growth will stem from the increasingly complex nature of the equipment used by the industry —particularly the ECO, multiplex transmission techniques, electronic data processing equipment, and data transmission equipment. Although routine maintenance on this equipment can easily be done by a worker in one of the traditional craft occupations, the more difficult repair operations will probably require supervision by an engineer or technician. Additional professional workers will also be employed in nontechnical jobs in marketing and advertising as the telephone industry attempts to improve its services and to inform the public of new services available, as well as in other parts of the business.

It is estimated that the industry will have to hire an average of about 4,000 workers a year for jobs in this category, of which only 1,000 to 2,000 persons will be required to replace those leaving the occupation.

Chart 9 Wire, cable, and conduit craftsmen, 1950–64 and projected 1970 and 1975



1/ Data include Class 'A' telephone companies only.

Source: U.S. Department of Labor, Office of Manpower Policy, Evaluation, and Research; 1956-64 data based on that appearing in Federal Communications Commission, Statistics of Communication: Common Carriers; and from the Bureau of Labor Statistics.

Many new occupational specialties will be included in the professional and semiprofessional worker category in 1975. For example, it seems likely that as complicated switching equipment relying heavily on electronic principles (crossbar and ECO equipment) comes into more widespread use, new technician specialties will evolve. Also, the widespread use of extremely technical equipment such as pulsecode modulation and microwave transmission facilities, teletype, data transmission, and electronic data processing equipment will also lead to new occupational specialties.

Entrance into professional or semiprofessional occupations will require college training in a 2-, 3-, or 4-year curriculum leading either to a bachelor's degree or an associate's degree. Although specialized training for a professional or semiprofessional occupation may be obtained in other ways (e.g., in some cases, for some semiprofessional occupations such as engineering technician or draftsman, training may be received on the job), a college background will become increasingly important. Although most openings will probably be filled with young college graduates, experienced telephone company personnel who attend evening college will continue to be upgraded. Telephone companies encourage their workers to improve themselves by reimbursing college enrollment expenses. For example, within the Bell System nearly 22,000 employees were enrolled in such programs in 1964.

Appendix

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List of Interviewees

In connection with this study, the following individuals were interviewed:

Company Officials

American Telephone and Telegraph Corporation, New York, New York

H. M. Boettinger, Assistant Vice President
C. K. Collins, Assistant Vice President—Traffic
P. A. Dolan, Public Relations Manager
S. G. Ericson, Assistant Vice President—Personnel Relations
J. A. Farmer, General Solicitor
J. G. Fox, Assistant Vice President and Attorney
R. W. Kleineit, Assistant Vice President—Plant
C. M. Mapes, Assistant Chief Engineer
A. D. Merry, Traffic Staff Administrator
W. A. Stevens, Director of Business Research

Bell Telephone Laboratories, Holmdel, New Jersey

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J. R. Harris, Director, Data Transmission Systems Engineering Center
W. Keister, Director, Electronic Switching Systems Engineering Center
R. W. Ketchledge, Director, Electronic Switching Laboratory
M. E. Terry, Director, Operations Research and Computation Center
K. G. Van Wynen, Head, Visitor Program Department
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J. B. Fisk, President, Bell Laboratories
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WHERE TO GET MORE INFORMATION

Copies of this publication or additional information on manpower programs and activities may be obtained from the U.S. Department of Labor's Manpower Administration in Washington, D.C. Publications on manpower are also available from the Department's Regional Information Offices at the addresses listed below.

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